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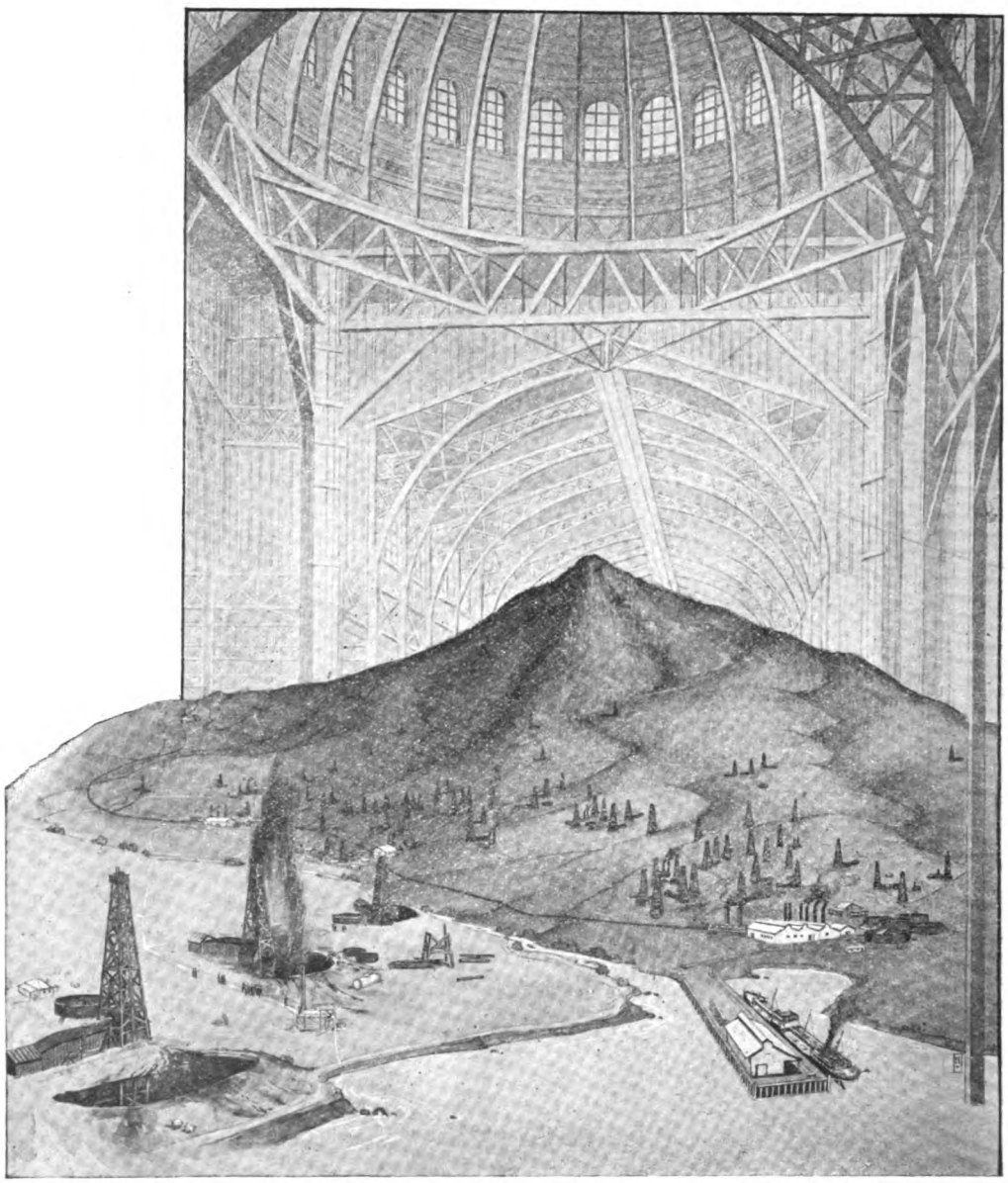

ARTISTS CONCEPTION OF THE SUGGESTED PETROLEUM EXHIBIT, PANAMA-PACIFIC EXPOSITION.
(See page 109 and 'Discussion' page 157.)

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EDITORIAL

READERS of *Western Engineering* who were interested in the account of the work done by Mr. Kamerlingh Onnes at the low temperatures' laboratory at Leyden, published in our issue of December 1912, will be glad to learn of the final success of his efforts to liquefy helium. The process involved includes compression to 75 atmospheres, followed by cooling in a bath of liquid hydrogen. At −259° Centigrade, the helium condensed to a bluish liquid, the temperature of which on boiling fell to −271° Centigrade. This is but 2° above absolute zero, which, according to accepted theories, is the lowest temperature obtainable. Mr. Onnes was awarded the Nobel prize of $40,000 for his work in physics, the liquefaction of helium coming as a final achievement after 12 years of experimental work.

THE part taken by engineers in the regulation of public utilities was the subject of an interesting discussion that took place in the auditorium of the Stevens Institute of Technology on January 9. As the personnel of the average public service commission is a result of political activity rather than a special fitness for the work, engineers thus far have played a subordinate part. There is no doubt that the engineering profession should be represented on public service commissions to at least as great an extent as that of the law. The majority of questions submitted to public utility commissions for settlement are technical in their nature and call for a high degree of knowledge and experience in the engineering profession. Nevertheless, these questions are generally settled by lawyers whose knowledge of engineering and business is based upon theory rather than experience. The legal profession nowadays is badly tangled with a mass of precedents and further complicated by the activities of legislative bodies in formulating all sorts and conditions of new laws with which to gratify the whims of the voters. It is not surprising that the fundamental issues are frequently overlooked altogether. The essential difference between the legal and engineering professions—and it is a big one—is that the lawyer bases his work upon a confused jumble of man-made laws, while the basis of engineering is the laws of nature itself. In an address delivered at the conference, Mr. Alexander C. Humphreys, president of the Stevens Institute said: "I hold that on every one of these commissions the engineering profession should be adequately represented in the person of men educated in the science of engineering and later trained in the hard school of experience." But few thinking men will disagree with the conclusions of Mr. Humphreys, but unless members of the engineering profession show a tendency to take an active part in party politics, there is not much chance that this hope will be realized.

WITH reference to the controversy over the selection of material to be used for top dressing on the state highways of New York, which was discussed editorially in our issue of December 1913, it is interesting to note that, on appeal, the Governor of New York, after consulting with the Com-

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missioner of Highways, the Attorney-General, and the Commissioner of Efficiency and Economy, has decided that hereafter asphalt shall be bought on open specifications and not under separate specifications for natural and oil asphalts as was proposed by the consulting board of highway engineers. This decision has met with general approval, as it places upon all bidders the duty of guaranteeing their material for five years and gives all an equal opportunity to sell asphalt to the state regardless of the method by which the asphalt is produced.

ATTENTION of all of our readers is especially directed to Mr. van Barneveld's suggestion in this issue for the mining and petroleum exhibit at the Panama-Pacific Exposition. The point at issue seems to be whether one general and comprehensive exhibit shall be made that will typify the California oil industry as a whole, or whether a series of unrelated county exhibits shall be prepared that will do little other than weary the observer by useless duplication. It is difficult for us to see why there should be any question as to a choice between these two ideas. There are a great many oil producing counties in California. Each has made an appropriation for a county exhibit providing various sums ranging from $3000 to $4000. These funds, however, are not devised exclusively for an oil exhibit. On the contrary, as all California counties are astonishingly prolific in producing the good things of the earth, a comparatively small proportion of the total appropriation will be available for petroleum. It is distinctly disappointing to contemplate the possibility of some fifteen or twenty exhibits arranged all in a row, each consisting of a few bottles of oil, some fossils, and perhaps an occasional model of a geological section to break the monotony. It hardly seems possible that the oil producers could be so neglectful of the opportunity presented as to prepare an exhibit of this character to greet the visitors from the four quarters of the globe as representative of the geographical section that produces no less than 40 per cent of the American supply of petroleum and 25 per cent of that of the entire world. Viewed from close range, our vision of the importance of the California oil industry seems to lack clarity to a remarkable degree. The rule apparently is—the farther away from California, the deeper appreciation of things Californian. It is a noteworthy fact that European investors in California oil properties are increasing to an astonishing extent, while California money seems lacking for the support of California enterprises. It is difficult to calculate the extent of the benefits that would accrue to everyone connected directly or indirectly with the California oil industry should an idea for a general exhibit such as Mr. van Barneveld has suggested be carried through to completion. The oil producer would benefit through giving the general public an adequate conception of the true meaning of oil production, and his efforts at financing would undoubtedly meet with a more ready response. The refiners, transportation interests, and the large financial institutions will participate in these benefits to just as great an extent as the man who produces the oil. It would be in the nature of a personal introduction between the production of the crude and the consumption of the refined product with all of the intermediate steps in logical sequence arranged between. By combining their energies and coöperating with one another for the good of the industry as a

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whole, the county governments, oil producing companies, transportation and refining interests can do themselves infinitely more good than by promoting individual exhibits that will differ from one another only in name.

The Diesel Engine

Most of us remember the story of the man from the rural district who, upon seeing a giraffe for the first time, looked the creature over and shaking his head turned away with the remark, "They ain't no such animal." This in brief has been the mental attitude of many Pacific Coast engineers toward the Diesel engine until the advent of the Diesel motor vessel *Siam*, which arrived in San Francisco early in January after a voyage of 15,000 miles. Tangible evidence of what must be regarded as a remarkable performance is far superior to hearsay, and under the circumstances it is not surprising that, after having taken advantage of the opportunity to inspect the *Siam's* power equipment and see it in operation, San Francisco engineers have found it advisable to execute a graceful flop in their opinions.

The *Siam* is a freighter and was built in the yards of Burmeister & Wain of Copenhagen, where the now famous *Selandia* was also built. The *Siam* is 425 feet long overall, 410 feet between perpendiculars, 55-foot beam, 33 feet molded depth and 30 feet depth to inner lining. The main engines are two in number, of the usual vertical marine type, each having 8 cylinders 590 mm. (23.23 inches) diameter and 800 mm. (31.5 inches) stroke. The 4-stroke cycle is used and the normal engine speed is 126 r.p.m., which drives the vessel at a speed of from 11½ to 12 knots per hour. Each engine cylinder develops about 175 horse-power on the brake, making a total aggregate horse-power of 2800. The compressed air for fuel atomization is supplied by a single cylinder high-pressure compressor direct driven and self contained with each of the two main engines. These compressors maintain a pressure of approximately 60 atmospheres.

In addition to the main engines there are two Diesel motor driven direct-connected electric generating sets of 250 hp. rating. As all of the auxiliaries, including the cargo winches and pumps are electrically driven, these two generating sets are used for central station service. One is constantly in use, the load being shifted from one to the other every ten days. Mounted on the same bed-plate with each of these engines is a vertical air-compressor which furnishes air at a pressure of about 20 atmospheres for atomizing, re-charging the air-bottles, and for starting the main engines.

The engine room crew consists of 8 engineers, including a chief engineer and an electrical engineer, and 4 wipers. The wipers stand one watch only, the electrical engineer also stands one watch, and his duties consist obviously of the care of all of the electrical apparatus on board the ship. The chief engineer exercises a general supervision over all of the mechanical appliances. Of the assistant engineers, six in number, but two are required per watch. A comparison of these conditions with those existing upon a steam vessel of similar size is striking. The fuel carrying capacity of the *Siam* is 1200 tons. The oil used is Borneo crude which has a paraffine base and from which the light fractions have been topped at a temperature of about 70° Centigrade. The cost is about 30 shillings per ton and the flash point 160° Fahrenheit.

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On her way to San Francisco the *Siam* put in at San Pedro harbor and took on board about 975 tons of California oil residuum from which the light fractions had been topped at the Trumble refinery of the General Petroleum Company. The run from San Diego to San Francisco was made using this fuel. Difficulty was experienced, however, in obtaining a proper atomization, as this residuum when cold is exceedingly viscous. The *Siam* is not provided with any means or facilities for pre-heating the fuel and consequently had to use it cold.

In the past, opinions have been freely advanced that California crude oil could not be successfully burned, preheated or otherwise in the Diesel engine. When it is taken into consideration, therefore, that a run of 28 hours was made with a California asphaltic residue, that this was done without pre-heating, and that it was pumped to the engines from storage in the double bottoms where only the thin steel outer shell of the vessel came between it and the sea water, the performance of the *Siam* is nothing short of remarkable. The fuel pumps and especially the suction and discharge pipes are not designed for so viscous a fluid. For this reason and also because there were no facilities on board for pre-heating , and that the *Siam* was bound for the Bering sea where both the atmosphere and sea water are exceedingly cold at this time of the year, the asphaltic residue was discharged at San Francisco and replaced with Star oil, a stove distillate made by the Standard Oil Company and costing about 90 cents per barrel of 42 gallons.

It is interesting to note that during the 15,000 mile voyage between Copenhagen and San Francisco one continuous run was made with the main engines driven at full speed for 39 days without stop or slowing down for any purpose. At the conclusion of this voyage the overhauling required was nothing more than an ordinary inspection of vital parts to see that they were in perfect working condition. Spare parts are carried in the engine room in racks, and include both inlet and exhaust valves, fuel valves, spare piston and piston rings, and two spare cylinders. While occasional changing of the fuel atomization valve is done, this represents the sum total of repairs, if it may be so called, that has thus far been required. What the life of the various parts of the engine may be can hardly be predicted, but in view of the marked absence of vibration when operating at full speed, it would appear that in this regard fatigue and consequent crystallization of parts will not take place any oftener than in a steam-driven vessel, and perhaps not so often.

Through the courtesy of Parrott & Company, the San Francisco agents for the East Asiatic Company, the Engineers' Club of San Francisco was invited to inspect the vessel on January 10. Some fifty engineers took advantage of this opportunity, and after several hours spent on board, came away with the idea firmly fixed in their mind that the Diesel engine had at last 'arrived.'

That the lesson taught by the advent of the *Siam* has already been given a practical manifestation is shown by the avowed intention of a number of San Francisco power users to install Diesel engines, and others are soon to follow. Our opinion that the territory tributary to the California oilfields is most favorable for the application of Diesel engine seems about to be justified.

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REVIEW OF THE MONTH

BUSINESS conditions have improved decidedly during the past month. The change has been more than local, and has manifested itself along the entire Pacific coast. Bankers have freely expressed their approval of the new currency law and have forgotten their earlier opposition. Their efforts are centred upon obtaining one of the regional reserve banks each in his own city. Money is easier, talk of panic has entirely disappeared, and the dirt will fly again as soon as the winter storms have abated. In the meantime, coincident with the acknowledged failure of the Pearsons to acquire petroleum concessions in South America, there is abundant evidence of renewed interest by British capital in Pacific coast enterprises. Thus far this has manifested itself principally in the refinancing of oil properties. However, the activities of foreign capital are by no means to be confined to petroleum, as is shown by the announcement recently made with regard to the 'Borax' Smith interests.

THE man of the hour in this transaction is Mr. George G. Moore. He and his English associates have agreed to provide funds for the rehabilitation and development of each unit that made up the United Properties Company of California and to place each firmly upon its financial feet. The scheme for re-financing includes the purchase by Mr. Moore of control of the Oakland Traction Consolidated. Although the holding company is to be disintegrated, it is altogether likely that the various constituent companies will be reassembled in a new combination in which Messrs. W. S. Tevis and R. G. Hanford will retain their original interest. Mr. F. M. Smith apparently has been finally eliminated, and will have to take what remains after the squeezing process is over The obligations undertaken by Mr. Moore and his associates may be briefly summarized as follows:

38,000 preferred traction shares held by United Properties trustees, at $30	$1,140,000
25,000 preferred traction shares held by Smith trustees for his creditors, at $30	750,000
Halsey notes, to be paid September 12, 1914	2,500,000
Key Route basin notes, to be paid November 20, 1914	1,100,000
Floating debt, traction companies.	1,000,000
United Light & Power Company of New Jersey debentures	1,600,000
United Water Co	800,000
New work contracted for	1,000,000
Total	$9,890,000

It is stated further that the same interests will undertake the rehabilitation of the United Light & Power Company and the Union Water Company as soon as these can be detached from the United Properties Company. In the meantime Mr. A. C. McClimont, who is engineer for Mr. Moore, has been appointed general manager of the Oakland Traction Consolidated and the Key Route suburban and ferry systems, succeeding Mr. W. R. Alberger, who, however, remains with the company as vice-president. The consummation of this deal does much to clarify the local financial situation and is another indication of a strong revival of business on the Pacific coast with special reference to public service corporations.

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RECENT events with reference to the California petroleum situation point to the fact that European capital recognizes the importance of the industry. First came the Royal Dutch-Shell Company with its large investments in California oil properties; then followed the advent of Messrs. Andrew Weir and R. Tilden Smith, and the formation of the Western Ocean Syndicate which has undertaken the re-financing of the General Petroleum Company. Coincident with this, the Natomas Consolidated, which, however, has been owned principally in England for some years, has been re-financed. While the Natomas was the outgrowth of the gold dredging interests controlled by Mr. W. P. Hammon and his associates, it has since developed into an irrigation scheme which in magnitude and potentialities has completely overshadowed the original enterprise. The company has been in the same relative position as many others during the financial stringency of the past six months, namely, it had a vast acreage partly reclaimed and ready for settlement, of which it was unable to complete development owing to the shortage in the money market. The security holders were, therefore, facing the disagreeable situation of owning shares in a partly finished enterprise which could not be made to produce until completed. All things point, however, to a settlement of these difficulties. The plan for re-financing provides for the formation of a new holding company, Natomas Limited, and an exchange of securities in the old company for those of the new. The new company is to advance $3,000,000 in cash to provide funds for meeting the old company's obligations, provided it can secure in exchange for its own securities $8,000,000 in first mortgage bonds, $2,000,000 in second mortgage bonds, and 51 per cent of all stock of the Natomas Consolidated of California, together with all reclamation district bonds now owned by the company or to be acquired later. It is stated that an excellent response has been made to this proposition on the part of the present security holders, and there seems to be every likelihood that the deal will be consummated.

IN line with the probability discussed in our January issue that Mr. Weir and his associates through their interest in Burmeister & Wain, the builders of the *Siam*, *Selandia*, and other Diesel motored vessels, that arrangements would probably be consummated to provide for the construction of Diesel engines on the Pacific coast, has come the announcement that a contract has been made with the Union Tool Company granting the right to build in the United States the Diesel engine of the Burmeister & Wain type. The Union Tool Company is a subsidiary of the Union Oil Company of California. The latter company is under option to the General Petroleum Company, which has just been re-financed by Mr. Weir and his associates, who are also interested in Burmeister & Wain of Copenhagen and in the East Asiatic Company, the owners of the *Siam*. The Union Tool Company has a manufacturing establishment at Torrance in southern California and is preparing to provide additional capital with which to go into the manufacture of Diesel engines on a large scale. This is the second Pacific coast concern to take up this work, the first having been the Dow Pump & Diesel Engine Company, which acquired the rights to the Willans Diesel engine about two years ago and has since installed a Diesel engine for operating its manufacturing plant.

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ANNOUNCEMENT has been made by the Standard Oil Company of California that a meeting of stockholders will be held on March 16 for the purpose of authorizing an increase in the capital stock of this company from $50,000,000 to $100,000,000. This company has outstanding approximately $45,000,000 par value of stock which at the present market price of $290 per share represents a value of more than $130,000,000. It has been stated that in 1913 the earnings of the company were nearly 24 per cent on its $45,000,000 capital, so if its earnings should not increase, they would be still in excess of 10 per cent on a capitalization of $100,000,000, provided the new stock issued brought no further assets. While it is not known whether the new stock will be distributed pro rata among the present stockholders in the form of a bonus, or whether it will be sold at par, it is generally considered that the need for additional capital has been brought about by the desire of the company to strengthen its position in view of the activities of English capital in the California field. That the company has resumed the purchase of the heavier oils was announced some time ago. This may be taken as another of the many signs of increased activity on the Pacific coast and a good omen for a prosperous year in 1914.

THE Union Oil Company has rejected the proposal for the purchase of its property by the Weir syndicate. The proposal made had no bearing upon the option held by the General Petroleum Company, but was an entirely new deal. The scheme as proposed involved the organization of the Union Oil Company of London, and all the stockholders of the Union Oil Company of California were to have had the privilege of exchanging their shares at par for 6 per cent preferred participating shares in the English company. Mr. Lyman Stewart is quoted as having said that the terms appeared to have been not only satisfactory, but very desirable for all parties concerned, but that a question arose as to the meaning of the word 'participating.' This was the rock upon which the parties to the negotiations split, so the scheme has been abandoned. The original option held by the General Petroleum Company holds, but it is an open question at present whether it will ever be exercised. This option expires on January 1, 1915, so nearly a year remains in which to put it into effect.

OIL operators in the Coalinga field have taken the necessary steps to perfect an organization similar to that of the Kern County Oil Men's Protective Association for the purpose of preventing the encroachment of infiltrating water into the oil sands. A number of the largest operating companies in the field have taken part in the organization. A committee of five has been appointed to take charge of the work, and according to the agreement entered into by the companies, there can be no appeal from the decision of this committee. They are given the power to appoint men to serve under them at a gross expense not to exceed $750 per month. The committee includes Messrs. R. C. Baker, Thomas Crumpton, R. S. Haseltine, C. A. Hively, and Seth Hardison. All of the companies operating in the district are to be urged to join the movement. There can be no question as to the necessity for conservation of the oil-bearing measures, and since the Governor failed to appreciate the exigencies of the situation, the oil operators themselves must act on their own re-

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sponsibility without the assistance of the state until such time as a better understanding of the situation obtains in Sacramento.

JUDGING by recent court decisions, the California Railroad Commission is in a fair way to become the most powerful ruling body in the state. The State Supreme Court has made a further extension of the jurisdiction of the Commission in a decision recently handed down whereby it is given authority to regulate traffic rates and exercise the same control over every steamship line plying between ports on the California coast now had over other common carriers and public utilities in the state. The decision holds that steamships plying between California ports are not engaged in commerce with foreign nations merely because their courses take them on the high seas and outside of the three-mile limit within which the state has jurisdiction. The case in point was that of the Wilmington Transportation Company against the California Railroad Commission. The former is a steamship line plying between San Pedro, in Los Angeles county, and Avalon on Catalina island. It is interesting to note that this decision is in direct contradiction to the case tried in 1883 in which the United States Circuit Court granted an injunction to the Pacific Steamship Company, the court holding at that time that as the vessel's course took it without the three-mile limit, any question of regulation was a matter for adjudication by the federal government. It is altogether likely that the United States Supreme Court will be appealed to for final judgment in this case. In the meantime, as far as the state courts are concerned, the hand of the California Railroad Commission seems to be strengthened at every turn.

ANOTHER interesting decision with reference to public utilities is that of the California Railroad Commission with reference to what is known as the Midway gas rate. The Midway Gas Company, a corporation, was organized for the purpose of piping natural gas for domestic purposes from the Midway field to Los Angeles, a distance of 111 miles. At this point the Midway Gas Company as wholesaler, proposed to deliver gas to the Southern California Gas Company as retailer, for distribution to domestic consumers. As domestic gas rates are determined by the Los Angeles supervisors, hearings had been under way before that body for some time before it was discovered that until the wholesale rate had been determined by the Railroad Commission, there was no basis upon which to arrive at the proper rate to be paid by consumers. A rate has been determined by the Railroad Commission of 14 cents per 1000 cubic feet, which is equivalent to a return of 10 per cent per annum upon the capital invested. In making its findings, it carried on a thorough investigation of all of the conditions governing the case, including geological studies, analyses of the gas, and estimates as to the probable life of the source of supply. It was indicated that the life of the fields would be from ten to twenty years. In arriving at a rate, therefore, the Commission has taken into consideration a 10 per cent depreciation on the capital invested in order that the cost of the entire plant may be amortized within a ten-year period. Estimating upon the life of gas wells is by no means an exact science and the capitalists who invested their money in this enterprise, are entitled to rates sufficiently high to return to them their original investment within a reasonable length of time.

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San Jose Municipal Natatorium

By E. F. CYKLER*

THE structural features of the San Jose municipal natatorium at Alum Rock park are worthy of note. In the design of the concrete slide, the diving and spring board platforms, the partitions around the individual bath rooms and the concrete arched ribs in the roof, a great deal of originality was shown, and in many cases no precedent was available to govern the design.

The natatorium is situated in Alum Rock park, which is the municipal playground, about seven miles east of San Jose, California, and served by an electric interurban line on the Peninsula railway system. To obtain water for this swimming pool, the old tank situated about a half mile farther up the canyon was converted into a reservoir and the creek flowing through the park furnishes a good supply of pure water. There is a large variety of mineral waters at the park and sul-

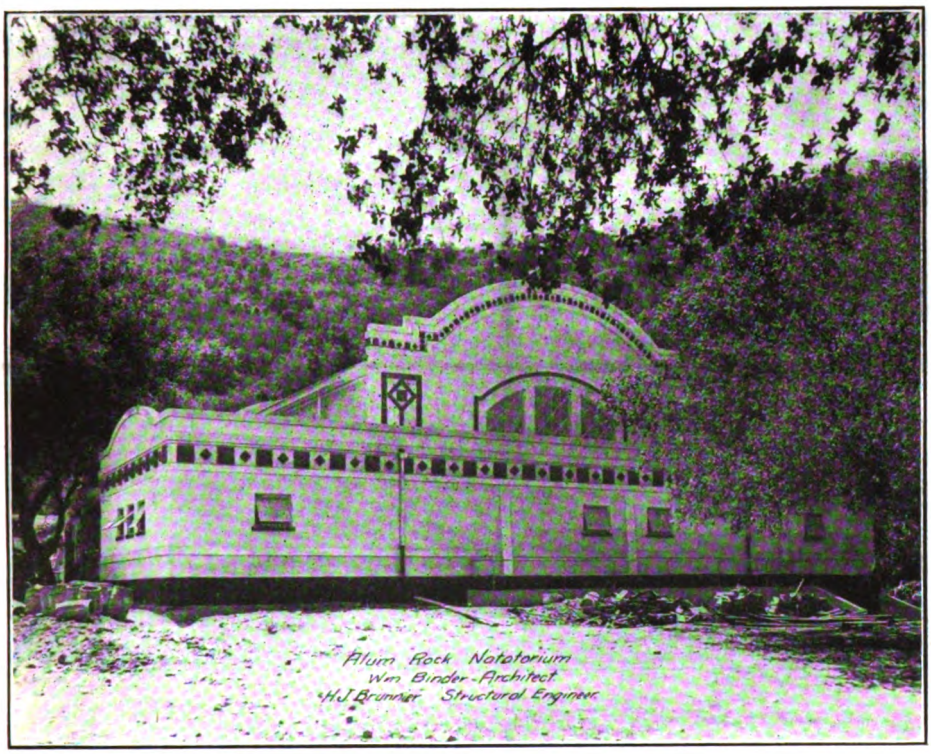

FIG. 1. MUNICIPAL NATATORIUM, SAN JOSE, CALIFORNIA.

*Assistant Engineer with H. J. Brunnier, Sharon Bdg., San Francisco.

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phur baths will be a prominent feature of the individual baths. The large swimming tank itself contains fresh water. The dimensions of the tank are 44 ft. wide by 90 ft. long, 3 ft. deep at one end and 7 ft. 9 in. deep at the other. The deepest portion of the tank occurs 15 ft. from the 7 ft. 9-in. end and is 10 ft. deep.

ness and one that would also give the body the proper position to leave the end of the slide without the sudden jar that is experienced in most slides. The curve that seemed to have the proper qualities was the parabola, and the slide was figured to conform to the equation $y^2 = 4ax$. Ordinates were figured for every horizontal foot, the

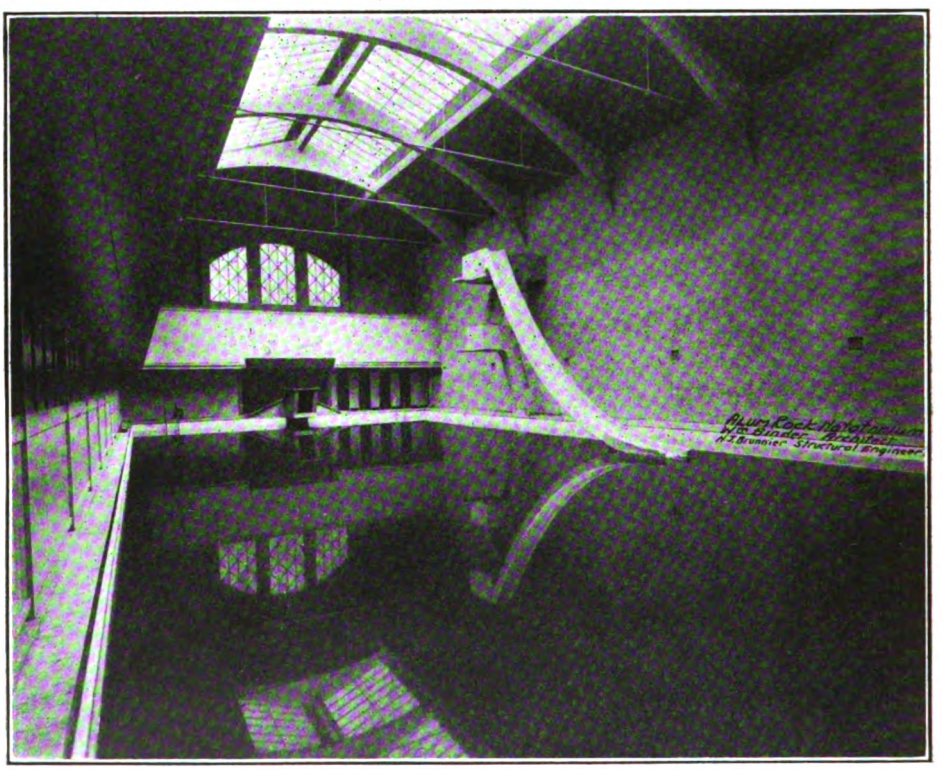

FIG. 2. INTERIOR OF NATATORIUM.

In making a study for the design of the concrete slide, shown in Fig. 2 and detailed complete in Fig. 3, almost all of the bath houses in the vicinity were visited to ascertain what the proper height and slope should be, also the distance between the end of the slide and the edge of the tank. These varied greatly and no set rule could be found, so that it was decided to design a slide that would give extreme smooth-

slide itself being 33 ft. long and 21½ ft. high, measured along its coördinates. These dimensions which are given on the drawings made it easy for erection and the result was a regular curve. The slide was figured as suspended from the platform, Fig. 3, and the steel was so placed as to take care of the resulting strains. It was figured to take care of a live load of 75 lb. per square foot over the entire slide in ad-

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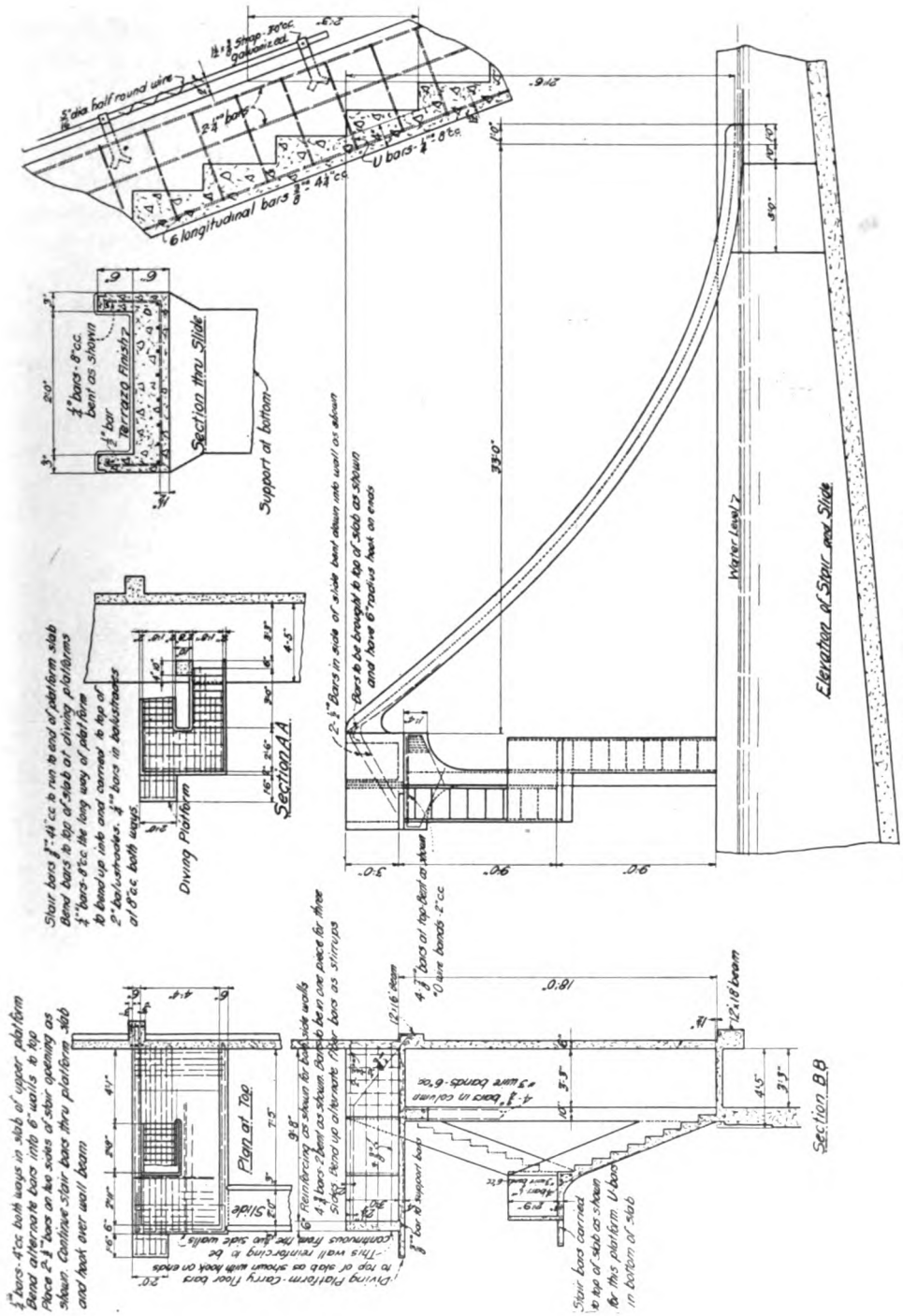

FIG. 3. STRUCTURAL DETAILS.

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dition to its own weight. The platform from which the slide was suspended is in turn a cantilever over an auxiliary 10-in. column. This is shown in the plan of the top of the platform, where it will be noted that one cantilever is connected rigidly to an exterior column, while the other cantilever frames into a 6-in. wall. It was assumed that under certain conditions the cantilever framing into the column might be thrown into tension due to the eccentricity of the slide, and therefore it was thoroughly anchored to the column as shown.

The steps and diving platforms, one at 9 ft. and one at 18 ft. elevation above water-level, were all designed in concrete with cement finish, and the slide was finished with terrazzo to insure absolute smoothness and lack of friction. This entire arrangement is compact and extremely rigid and makes a pleasing appearance as shown in Fig. 2.

The diving and spring-board platform was also built of concrete and designed as a cantilever, so as to avoid all obstructions in the tank proper. Fig. 4 shows details of placing the reinforcement and method of framing the spring-board into the platform. The platform is carried by two cantilevers each 8 in. wide, one on either side of the spring-board. The surface of this platform was rough cement finish to afford a good grip for the feet.

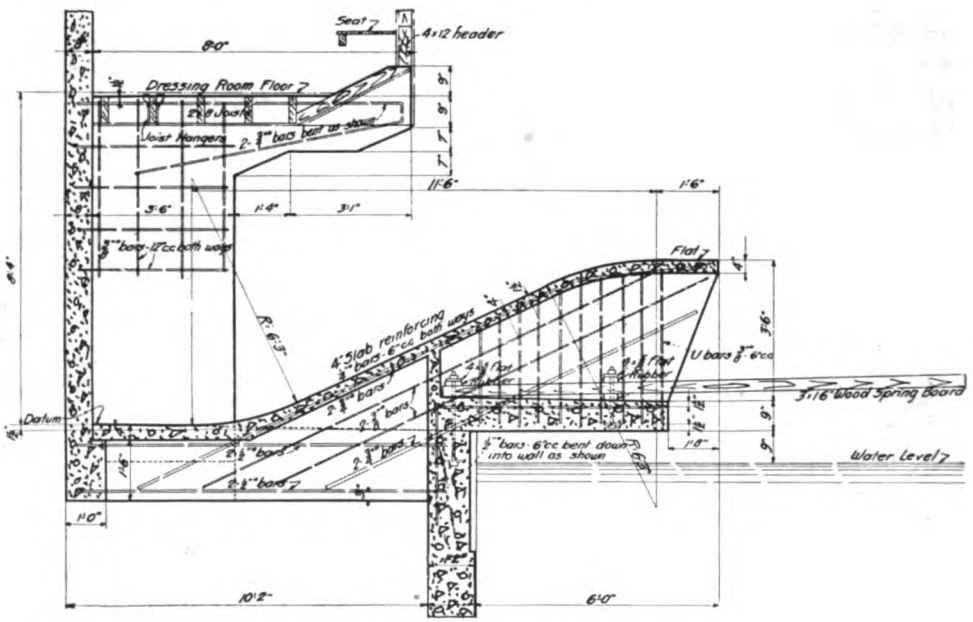

FIG. 4. DETAILS OF SPRING-BOARD.

The partitions around the individual bath rooms have caused a great deal of comment on account of their stiffness. By reason of the sulphur water, no marble partitions could be used, as they soon would be attacked chemically and give a stained appearance. 'Self-Sentering' was used in these partitions and no framing was required with the exception of a channel iron on each

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side of the door, which was securely dowelled into the floor slab. The floor was also finished with tile, but shows, in the illustrations, covered with sand to protect it during construction. The plastered partitions were 1½ in. and the finished ones 2½ in. thick.

The design of concrete arch ribs for roof construction is also a very interesting feature. They are considered fixed ended in design and figured for a dead load of 45 and a live load of 20 lb. per square foot, exclusive of the weight of the arch rib itself. They were also figured for a rise and fall of temperature in either direction of 50°, or a total range of 100°. To take the maximum horizontal thrust, 2½-in. tie rods upset to 3¼-in. diameter at the ends were used. These tie rods were supported by ½-in. eye bolts spaced uniformly along the arch and anchored into the concrete rib. The rib itself was 12 in. wide reinforced with four 1-in. bars, top and bottom and tied together with No. 0 wire bands 12 in. on centres. Reinforced concrete beams to carry the wooden roof joists were framed into the arches as shown. These arches were spaced 16 ft. on centres and carried by 12 by 18-in. columns. The entire arrangement gives a pleasing appearance. The building is now open to the public. William Binder of San Jose is the architect and H. J. Brunnier is consulting structural engineer.

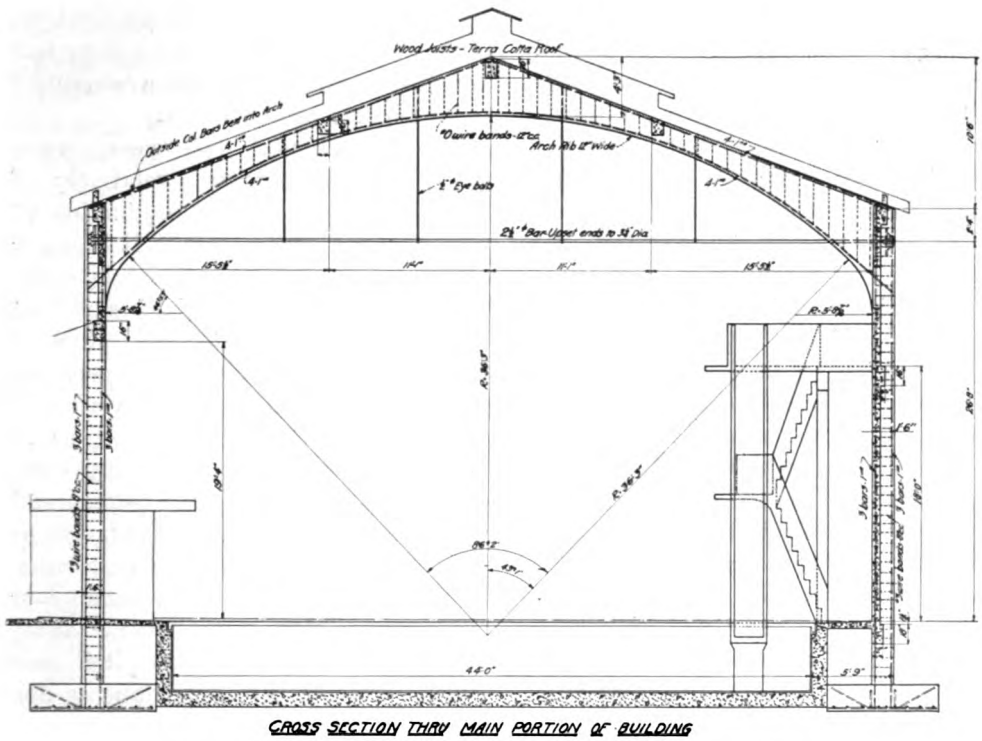

FIG. 5. CROSS-SECTION THROUGH MAIN PORTION OF BUILDING.

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Inductive Interference Between Power and Communication Lines*

SINCE the last progress report of September 1, 1913, the Joint Committee on Inductive Interference, authorized by the California State Railroad Commission, has given a great deal of consideration to the analysis of results obtained from the several parallels on which an investigation has been conducted, together with the preparation of a program of work to be carried out by the committee in the immediate future.

The parallels concerned in this study are described in the last progress report from the committee.† The principal exposures are, briefly, two parallels, (20 miles and 8 miles), between the 57,000-volt, 3-phase line of the Sierra & San Francisco Power Co. and the main coast line toll lead of the Pacific Telephone & Telegraph Co. between San Francisco and Los Angeles. In addition to the telephone lead, circuits of the Western Union Telegraph Co. are paralleled by this line in portions of its length. The high tension line in question is supplied by auto-transformers at the Guadalupe substation and supplies 33,000-volt and 22,000-volt lines of the Coast Valleys Gas & Electric Co. through auto-transformers at Salinas. South of Salinas, the above mentioned telephone lead is paralleled by the 33,000-volt line of the Coast Valleys Gas & Electric Co. for a distance of 41 miles between Salinas and King City. The telegraph circuits of the Western Union Co. are also exposed to this high tension line. In all cases the power and telephone lines are on opposite sides of a public highway. The Sierra & San Francisco Power Co. operates with a grounded neutral. Tests were made under conditions of grounded and non-grounded neutral of the star-connected auto-transformers at Salinas. There are no grounds beyond Salinas on the 33,000-volt and 22,000-volt lines supplied by these transformers.

The mass of experimental data and the studies concerning these exposures are embodied in some 30 technical reports. Some of the general results and conclusions indicated by a study of these reports are as follows:

The fundamental, (60 cycle), wave of voltage or current is relatively of little importance in the production of noise in telephone circuits. It becomes of importance, however, if it gives rise to longitudinal voltages of sufficient magnitude to constitute a physical hazard, to interfere with the operation of grounded signaling devices or superimposed telegraph service, or to operate protective apparatus on the circuits. The harmonics of the voltage and current waves are of chief interest as the cause of noise in telephone circuits, particularly the higher harmonics or those within the range of the voice frequencies. The fundamental and lower harmonics are important as disturbing factors in telegraph circuits.

The above facts show clearly the great desirability, from the standpoint

*General progress report of joint committee, Dec. 16, 1913.

†*Western Engineering*, November 1913.

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of inductive interference, of having wave forms of voltage and current in power circuits free from all harmonics. That such does not obtain in the present state of the art is a basic cause of the disturbance to communication circuits paralleled by power circuits. Further than this, these facts emphasize the desirability that designers and manufacturers eliminate, as far as is practicable, those features of design favorable to distorted wave forms.

In order to facilitate the analysis of the inductive effects of a power circuit on parallel communication circuits, the voltages and currents of a 3-phase power system can be conveniently regarded as made up of components which exhibit distinct characteristics and treated separately. In any 3-phase system in which the three voltages between pairs of wires are equal in magnitude the voltage between any wire and ground can be considered to be the vector sum of two voltages which are called the balanced and the residual components respectively. The balanced components consist of three equal voltages between the three wires and ground, the vector sum of which is zero. The residual components consist of three equal voltages between wires and ground which are in phase with each other. The residual voltage of the system is defined as the vector sum of the voltages of the three conductors to ground. It is, therefore, three times the residual voltage of the individual conductors or three times the equivalent single phase voltage of the three conductors in parallel with respect to the earth. The currents flowing in the three wires of a 3-phase circuit may be considered to be composed of three sets of currents, namely: (1) balanced components consisting of equal currents in each of the three line wires whose vector sum is zero; (2) a single phase current flowing in a loop composed of two of the wires; (3) a residual current divided equally between the three wires and returning through the earth. Residual current is defined as the vector sum of the three line currents. It is, therefore, the equivalent single phase current flowing through the three line conductors in parallel with the earth completing the circuit. Connections of current and potential transformers are arranged for measuring the residual current and residual voltage of power circuits under investigation.

For the purpose of clearness, it is convenient to classify induction phenomena as longitudinal or transverse referring to their manifestation on a metallic circuit. Longitudinal induced voltage refers to the voltage induced between the circuit and ground in the case of electrostatic induction and along the circuit between the two ends of the exposure in the case of electromagnetic induction. The transverse induced voltage of a circuit is the difference between the longitudinal induced voltages of the sides of the circuit. In the case of electrostatic induction this voltage acts between the two sides of the circuit and in the case of electromagnetic induction it acts around the metallic circuit.

It has been found in the case of the power lines investigated that the fundamental 5th, 7th, and 11th harmonics are prominent in the balanced currents and voltages while the fundamental, 3rd, and 9th harmonics are prominent in the residual currents and voltages of the power system.

By a comparison of the prominent harmonics in the currents and voltages of the power system with those of the induction in the telephone circuits it is evident that the longitudinal induction arises principally from the residual

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voltages and currents while the transverse induction shows principally the characteristics of the balanced voltages and currents together with some effect from the residual voltage and current.

The effect of the condition of the neutral of the auto-transformers at Salinas, grounded or non-grounded in so far as the induction from these exposures is concerned, is through the residual currents and voltages of the several high tension lines connected to these transformers. A representative value of the neutral current at Salinas during the tests conducted at that point is 0.3 ampere. It is composed almost entirely of 9th harmonic together with the fundamental and 3rd harmonics, decreasing in magnitude in the order named. The length of the power circuit between Guadalupe and Salinas is approximately a quarter wave length for the 9th harmonic. This fact may have some bearing upon its large magnitude and is to be further investigated by the committee. Under existing conditions with the power system in normal operation, grounding the neutral of the auto-transformers at Salinas does not greatly affect the induction in the exposures concerned. Two reasons may be given for this result: (1) the load balance on the power system is such that a relatively small amount of load current flows through the neutral; (2) as three high tension lines are connected together by the auto-transformers at Salinas, opening the neutral connection to ground of these transformers does not completely eliminate the path for the residual current of any one of the three lines, since it may then flow to earth through the admittance to ground of the other two lines. It is quite evident from these considerations that this case presents special conditions which make it impossible to draw general conclusions applicable to any other case. Further consideration of the effect of grounding this neutral will probably be undertaken by the committee with the idea of determining its effect under abnormal conditions.

The banks of star-connected auto-transformers at Guadalupe and Salinas substations are provided with closed delta secondary windings which supply power for local consumption. For test purposes the secondary delta of the transformers at Salinas was opened. A large increase in the residual voltage and residual current with a consequent large increase in the induction in parallel telephone and telegraph circuits resulted. In all cases this increase applied particularly to the 3rd harmonic. If star-connected auto-transformers are used, this test indicates, therefore, that from an induction standpoint it is beneficial to provide such auto-transformers with secondary windings connected delta.

On the 8-mile exposure it was possible to measure separately under different conditions of the telephone circuits, the electromagnetic and electrostatic induction. For this exposure, also, computations of the magnitude of the induction, both electromagnetic and electrostatic, were carried out. In computations of electromagnetic induction, experience has indicated that the distances between wires and their images cannot be assumed to be twice the height of the wires above the ground. Special tests were carried out in order to determine the equivalent depth of the image conductors. These tests indicated this depth to be approximately 300 metres below the earth's surface. Due to the electrostatic shielding effect of neighboring objects it was found, also, that the computed electrostatic induction was greater than that actually observed, indicating that

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in effect the ground surface was brought nearer to the conductors. Electrostatic shielding of the circuits under test, by grounding other circuits on the telephone lead at one point, reduced the electrostatic induction, particularly the longitudinal induction.

The effect of typical terminal apparatus of a telephone circuit in reducing the amount of extraneous current reaching the telephone receiver was the subject of some investigation. These efforts vary with the length of the line and character of the induction.

As a means of minimizing inductive interference, some study has been given to the proper relative transposition of power and telephone circuits. Some of the considerations involved in this study are given in the portion of this report dealing with the future work of the Committee.

The field engineering staff of the Committee is now at Santa Cruz and is investigating the parallel between the 22,000-volt 3-phase line of the Coast Counties Gas & Electric Co. and a toll lead of the Pacific Telephone & Telegraph Co. This parallel is between Santa Cruz and Watsonville and is approximately 17 miles in length, the two lines occupying opposite sides of the public highway. The system of the Coast Counties Gas & Electric Co. is isolated from ground. The high tension line involved in this exposure may be taken out of service when occasion requires and used for experimental purposes.

The Committee plans to conduct on this exposure a series of tests for the purpose of determining the effectiveness of several different systems of transpositions of the power and telephone circuits. In considering transposition systems for parallel power and telephone circuits account must be taken of the effect of such transpositions on the different types of induction arising from the different components of the voltages and currents of the power system. The longitudinal induction arising from balanced voltages and currents can be made as small as desired by the insertion of a sufficient number of properly located power circuit transpositions. The longitudinal induction arising from the residual voltage and current of the power circuit is unaffected by power circuit transpositions except in so far as the magnitude of the residual voltage and current is affected by such transpositions. Transpositions in a power circuit tend to equalize the capacities of the three phases to ground and, hence, reduce any residual voltage which may be due to inequalities in the capacities of the three conductors to ground. Residual voltages and currents give the same inductive effects as a single phase grounded circuit operating with the three power conductors in parallel. For this reason residual voltages and currents, though small in comparison with the balanced voltages and currents, have proportionally a very large effect in producing longitudinal induction in nearby circuits. The longitudinal induction arising from either the balanced or residual voltages and currents is independent of the transpositions in the telephone circuits. The large inductive effects resulting from a relatively small residual voltage or current and the inability to reduce the longitudinal induction arising therefrom render highly desirable the elimination from the power system of such residual components of voltage and current. The transverse induction from residual currents and voltages can be reduced by transpositions in the telephone circuits which tend to equalize the induction into the two sides of the circuit by exposing each side equally to the effect of

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the power circuit. The transverse induction from balanced currents and voltages is affected by transpositions in both the power and telephone circuits.

The problem of designing transpositions to minimize the inductive interference between parallel power and telephone circuits is further complicated by the elaborate transposition system of the telephone circuits which is designed to reduce the induction or cross-talk between different telephone circuits. In order to be most effective in reducing inductive interference it is absolutely essential that the transpositions in the power and telephone circuits be located with due regard to each other.

By the experimental study of transposition systems being conducted at Santa Cruz, the Committee hopes to be able to determine:

a. The effect of power transpositions in reducing the longitudinal inducton arising from balanced currents and voltages.

b. The effect of telephone transpositions in reducing the transverse induction arising from: (1) residual currents and voltages; (2) balanced currents and voltages.

c. The effect of power and telephone transpositions properly located with respect to each other in reducing both the longitudinal and transverse induction arising from balanced currents and voltages.

d. The relative effectiveness of different transposition systems in reducing electrostatic and electromagnetic induction.

In its application to other exposures the information to be obtained from this experimental study will be chiefly of value in indicating the limits and refinements within which it is necessary to work and the accuracy with which the effectiveness of any proposed system of transpositions may be predetermined.

In addition to the study of the effect of transpositions the Committee will undertake in the near future to determine the effect of known amounts of noise (extraneous current), in the telephone receiver in reducing the intelligibility of conversation over a circuit. As the first step in this investigation, tests will be conducted to determine the detrimental effect of known amounts of single frequency extraneous current in reducing the intelligibility of conversation. This detrimental effect will be rated as the equivalent of an increase in the length of the circuit. From such tests with single frequency extraneous currents the relative detrimental effect of currents of different frequencies will be obtained.

This, together with information as to the detrimental effect of currents of complex wave form, will give information by which the law of the combination of the single frequency effects can be obtained.

Until such time as the Committee is prepared to make recommendations to the Railroad Commission it feels at liberty to indicate only in the most general way the results of its investigation. Since its formation, a year ago, the work of the Committee has served to emphasize to all members the magnitude of the problem under investigation and the necessity of a thorough consideration of the subject in all its different phases, before the Committee, in justice to itself and to the Railroad Commission of California, can make final recommendation to that body for its action.

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Panama-California Exposition, San Diego

By F. P. ALLEN, Jr.*

THE Panama-California Exposition is being built in Balboa park, a city park, one and one-half miles square. Many improvements, (of which the bridge is one) in connection with the Exposition are designed as permanent improvements for the park, and after the Exposition is over this bridge will be the principal means of reaching the central portion of the park, as the canyon, which it crosses, extends the full length of the park.

The architectural style adopted for the Exposition is Spanish-Colonial. An investigation of the various bridges built in Spain during the Middle Ages and, in fact, up to modern times, shows that most of them were composed of full centred arches of comparatively short spans. Most of them were more or less in the style of the Roman aqueducts. This, together with the greater economy achieved, was the reason for deciding upon a bridge of uniform, full centred arches, having spans of 56 ft. each.

It can easily be seen that true arches would develop a thrust which would be quite expensive to handle on such long slender piers as those occurring in the centre of the bridge. It was found necessary (for architectural reasons) to have solid spandrels, so the designers of the bridge decided to thicken the spandrels and use them as cantilevers. The arches are consequently cut at the crowns. The piers are very simple and cheap, as shown by the plans. The resultant for the sidewalk cantilever falls well within the middle third of the pier. The resultant in the roadway cantilever, however, falls slightly outside the middle third of the pier. For this reason two columns were substituted below the cantilever, and designed as a cantilever over two supports. The bridge was designed to carry two 15-ton rollers, passing any point, and a live load of 100 lb. per sq. ft. on the balance of the structure. The computations are comparatively simple, and the design is obvious. This structure will be found interesting, as it is apparently the only one of its peculiar design.

The bridge was designed by the writer, assisted by T. B. Hunter and G. R. Haylor, assistant engineers in the Division of Works.

Fig. 1 is a view of the bridge from the canyon and shows the full length of the bridge. At the left-hand side of the illustration can be seen the retaining wall that forms the west approach. This figure also plainly shows the method of construction. All sand and stone is brought in at the level of the bridge floor in automobile trucks, carrying 4 cubic yards each. These trucks travel out to the end of the column and girder section and there dump into chutes which carry the material down to the bins below. The bins have a capacity of 300 yd. of crushed stone and 150 yd. of sand. From the bins the sand and gravel flow by gravity into a measuring hopper and

*Director of Works, Panama-California Exposition, San Diego, Cal.

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then into a mixer. The mixer discharges into a skip which is hoisted to the top of the tower and discharged into distributing chutes. The skip takes a complete batch (24 cu. ft. of concrete) each trip.

The chutes are shown as arranged for pouring the cantilever section. Fig. 2 shows a more detailed view of the chute arrangement.

Fig. 1 gives a good view of the false work and a more detailed view of the spans. Fig. 2 shows the distributing chutes. This is a simple and cheap arrangement. The box to which the main chute from the tower leads contains a gate which can be thrown either way to send the concrete to the end desired. The discharge chute can be handled and maneuvered by one man.

The bridge, a reproduction of a famous Spanish structure, will be 900 ft. long, 40 ft. wide, and will span a lagoon at a height of 115 ft. above the water. It will be a seven-arch bridge with enclosed beam and girder approaches. At both ends there is an earth-filled retaining wall. These walls are of box type, the sides being reinforced slabs 12 in. thick tied together with steel rods bedded in concrete. The end wall of this section is of the buttress type. The two buttresses serve not only to take the overturning thrust of the earth fill, but also to carry the ends of the concrete girders of the approach spans.

The east approach consists of two roadway girders, 17 ft. centre to centre, each 2 ft. wide by 3 ft. 8 in. deep, and 144 ft. long supported by columns 24 ft. centre to centre, and two smaller girders at the edge of the sidewalk, with transverse floor beams 8 ft. centre to centre carrying the floor slabs. The parapet wall along this section is carried to the ground, completely enclosing the girders and supporting columns. The west approach is a similar section 72 ft. long.

The bold and unusual features of this bridge are in the section between the two approaches. To the casual observer, the structure will have seven arches each of 56-ft. span with piers 12 ft. wide. A closer inspection, however, will reveal expansion joints at

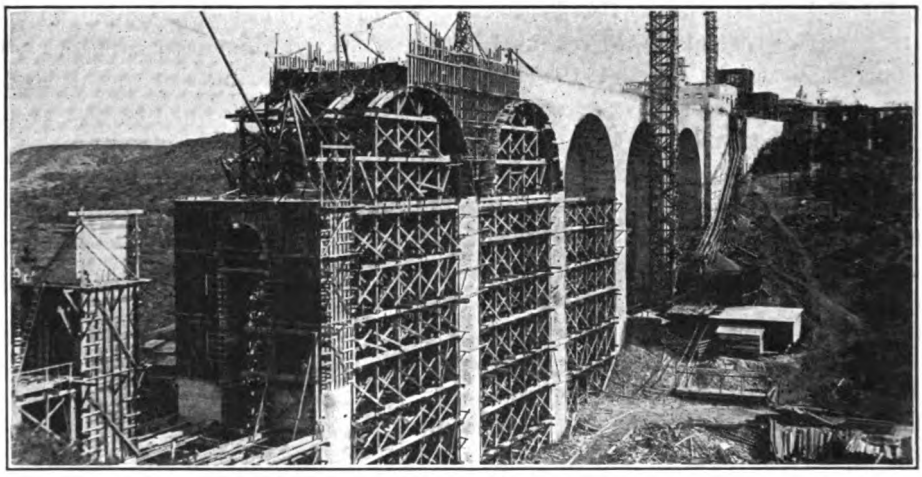

FIG. 1. REINFORCED CONCRETE BRIDGE UNDER CONSTRUCTION.

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the crown of each arch. This design limits the effect of temperature changes to the portions between the crowns of adjacent arches. To do this the bridge was designed, not as a series of elastic arches, but a series of balanced cantilevers resting on the piers.

The roadway slab is carried on transverse floor beams and the sidewalk slab on 6-in. vertical walls which also tie the roadway and sidewalk cantilevers together. The roadway cantilevers rest on reinforced columns. The sidewalk cantilevers are carried to the foundations as a reinforced section 15 in. wide and 12 ft. long.

To stiffen the structure and more completely tie the roadway and sidewalk cantilevers together, a 6-in. soffit will be built between the roadway and sidewalk cantilevers. The pier is 41 ft. 8 in. wide but at this section will be divided into two parts, which are connected by a transverse arch. The piers below this section are stiffened by horizontal diaphragms 8 in. thick, 15 ft. centre to centre.

The foundations present no new or unusual features. The columns carrying the roadway cantilevers rest on reinforced slabs 12 by 24 by 3 ft. thick and the sidewalk cantilevers on reinforced slabs 6 by 20 by 2 ft. 3 in. thick.

The reinforcing of the 6 and 8-in. diaphragms consists of a double system of diagonals usually of ½-in. rods spaced 24 in. centre to centre. The floor slabs are reinforced with Kahn sheared bars; floor beams and girders are with ¾-in. and 1-in. bars. All steel for the bridge is being furnished by the Trussed Concrete Steel Co. of Detroit, Mich. There will be used in the construction of this bridge 7700 cu. yd. of concrete and 350 tons of steel.

Many other permanent structures planned by the Exposition will be built of concrete. The California building at the east end of the bridge, with its tower rising 180 ft. above the level of the bridge floor, will be built of reinforced concrete. Concrete is being used in the construction of the sanitary and storm water sewer systems as be-

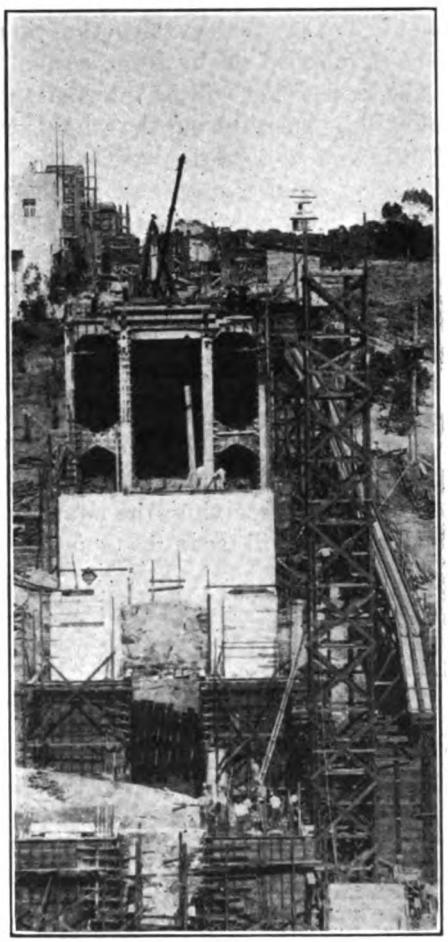

FIG. 2. END SECTION OF BRIDGE.

ing the most economical material for this purpose.

A combination of beautiful but simple architecture, and a wonderfully instructive revelation of things that man is doing and how he is doing them, how he lives and how he earns his livelihood, with striking comparisons of the difference between human aspirations

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and processes used in this and in bygone generations, will make the San Diego Exposition in 1915 different, and the visitor will find much of interest, pleasure, instruction, and inspiration.

All the work of designing and constructing the Exposition's many structures is being done by the Division of Works. All construction work is being carried on by force account.

The Exposition will be international, and will be open during the whole year of 1915. It will be devoted to the exploitation of the west and southwest and will cost approximately $15,000,000 when completed. The work of building is approximately two-thirds completed. The Administration building, Service building, Electricity building, and Emergency hospital have been entirely completed, as well as the buildings required for the Nursery. The Machinery building and Mining building are now receiving the staff and plaster, and will soon be completed. The Foreign Liberal Arts building and the Agricultural building have been erected and are now ready for staff and plaster. The grading and the sewer and water systems are entirely completed and the laying of gas mains and electric conduits will be started within the next thirty days. The heavy planting on the hillsides and in the canyons has been entirely completed, and the more formal planting around the buildings will be commenced immediately.

Construction of the bridge was started late in December 1912, but owing to the fact that great difficulty was encountered in obtaining clean stone and sand, the work was delayed for nearly five months. Since this difficulty was overcome, construction has gone forward very rapidly, and the work is now progressing at the rate of one complete section (68 lin. ft. of bridge) every two and one-half weeks, which is fairly rapid progress.

Use of Oil in Locomotives

THE chief engineer of the Canadian Pacific railway recently made a trip of inspection to Vancouver and Victoria for the purpose of investigating the cost and feasibility of using oil in the locomotives on the Cascade subdivision of the British Columbia division, both in passenger and yard engines. Oil tanks will be established at Vancouver, Coquitlam, Mission Junction, and North Bend to supply the fuel for the locomotives. The work of converting will be done at the local shops. Oil has been used for fuel purposes for some time on the sections between Kamloops and Field, and it is planned to extend the system to the other portions of the road. Engines on some of the branch lines of the province have also been using oil for fuel. After the engines on the Cascade division have been changed and placed in commission it is intended to extend the plan to the section between North Bend and Kamloops, completing the change on the entire British Columbia division.

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California Methods of Preventing and Extinguishing Oil Fires

By C. P. BOWIE*

CONSIDERING the large amount of oil produced in California annually (in 1913 upward of 93,000,000 bbl.) and the fact that the greater portion of it must be pumped hundreds of miles through pipe-lines to bring it from the interior of the state to marketing places along the coast, the percentage of fire loss is practically nil. This is due largely to two factors, one that the majority of oil produced in the state up to the present time has been from 14° B. to 20° B., which has a relatively high flash point and, therefore, does not easily ignite; and the other that the portion of the state in which it is produced and through which it is transported by pipe-lines is seldom frequented by severe electric storms, as is the case in many of the Eastern fields. However, too much credit for this exceedingly small loss cannot be given to the splendid fire discipline inaugurated from the outset and unceasingly maintained at all producing wells, storage farms, pumping plants, and delivery stations. Smoking is strictly prohibited in the vicinity of tanks containing oil, all refuse and inflammable material is carefully cleaned up and removed, oil is not allowed to stand in open sumps where cigarette stubs thrown by the careless passer-by may alight to start a conflagration, grass is cut down before it is allowed to dry and is taken to a safe place and burned or otherwise disposed of, and lastly, in most places, the premises are surrounded by a high and well-set fence and everlasting vigilance maintained to prevent the wandering hobo from following his compelling propensity to kindle his 'Mulligan' fire on the leeward side of the storage tank.

At pumping plants and tank farms, steam smothering lines are run from the boilers to all oil tanks, ending beneath the roofs, which are made of wood, near the centre of the tanks, and so arranged by means of a side outlet cross, that the steam will be discharged parallel with the roof into each quadrant of the tank through nipples about 3 ft. in length, the ends of which are partly closed by flattening. Whenever possible, tanks are given a clearance of 200 ft. or more, and around each a levee is constructed of sufficient height to impound the entire contents. When a tank catches fire the steam from all available boilers is turned into the smothering line and every effort made to save it while the roof remains intact. This method, however, can be depended on to be effective only so long as the greater portion of the roof remains, since the function of the steam is to fill that part of the tank between the oil and the roof, thereby excluding the oxygen of the air from the burning surface. As tanks used for storage are usually about 114 ft. in diameter, the absence of a relatively small amount of the roof will permit the

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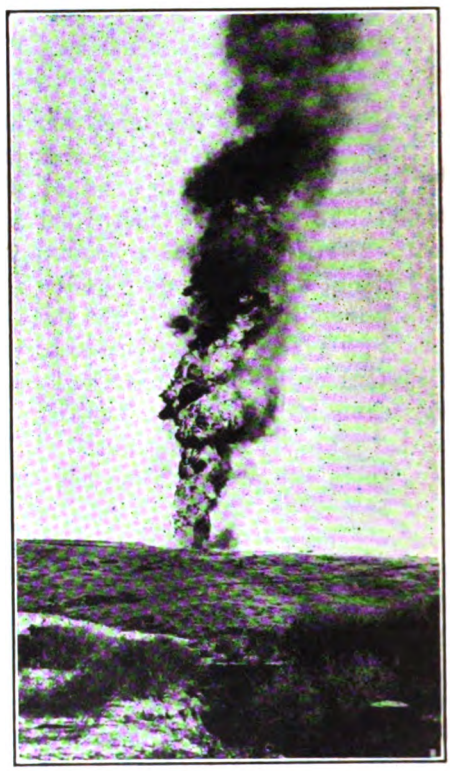
escape of enough steam to leave portions of the space not filled in which the blaze may burn undisturbed and soon render the whole process useless. In such a case all that can be done is to draw out as much oil as possible through the drain pipes in the bottom of the tank and convey it to a place of safety. Sometimes this is impossible for the reason that the other storage places in the vicinity, if there are any, may already be filled to capacity, and there may be no sump so situated that its being filled with oil will not jeopardize adjacent structures. In such a predicament there is nothing left to do but let the tank burn. However, at all events, the water bleeder in the bottom of the tank, which is a pipe 6 in. diameter, is kept open. Nearly all oil coming from the wells contains at least from 2 to 3% of water. As the oil becomes heated in burning, this water finds its way to the bottom of the tank, and unless it is drawn off, will be converted into steam, the accumulation of which causes the blazing mass to explode or boil over the edges of the tank violently, and in this blazing effervescent state has been known to run along the ground for several hundred yards, passing entirely over the top of levees 10 ft. or more in height, and dealing havoc to adjacent property.

The so-called froth method of fighting oil fires has been installed at the Standard Oil Company's refinery at Point Richmond, where it has been successfully used on several occasions. This method is better adapted to tanks of small area such as are used for the storage of gasoline and refined oils than field tanks which are usually of large diameter. It consists essentially of mixing two liquids, which will produce a foam, in an air-tight tank, the walls of which are of sufficient strength to admit of the foam being forced out of the tank under pressure by the carbon dioxide gas generated, thus making it possible for the foaming liquid to be transported through pipes or hose



BURNING WELL, KERN TRADING & OIL CO., MIDWAY FIELD.

to the fire. One of these liquids is an alum solution and the other contains sodium carbonate and glue or casein. The froth formed is quite stiff and the bubbles will stand exposed to the air for a considerable length of time before bursting. The virtue of this substance as a fire fighter lies in its ability to form a blanket of bubbles over the surface of the burning oil and exclude the oxygen of the air. The bubbles themselves contain carbon dioxide and on bursting, form an atmosphere in which combustion cannot take place.

In drilling wells in gusher territory every precaution is taken to prevent

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the well from catching fire when it is brought in. The boilers for the rig are placed at a safe distance from the derrick and where possible are abandoned entirely as the tools begin to pierce the formations adjacent to the oil sand, steam being piped in from some other source out of reach of spray from the gushing oil; tools are taken entirely away from the rig to be sharpened, and lastly a sump is constructed of a size estimated to hold the flow from the well until such time as the output can be controlled by means of valves placed on the casing head.

When a gusher does catch fire it is generally the practice to smother the flame with steam and this task is more or less Herculean depending on the amount of oil and gas the well is producing, especially on the amount of gas. In a comparatively recent fire in the Midway oilfields it required the steam from eighteen 100-hp. boilers to conquer such a fire. In this connection a method successfully used to subdue and finally to conquer the flames of a burning well of the Kern Trading & Oil Co. on Section 29, T 31 S, R 23 E in the Midway field is worthy of note, it being an innovation so far as extinguishing oil fires in the California fields is concerned. The well, which was situated on the side of a hill, was drilled by contract. It was brought in early one morning last fall. The territory was known to be of the gusher variety and all the above mentioned fire precautions had been observed. However, the oil sand was not expected until a depth of 3000 ft. had been reached and was actually encountered at about 2900 ft. so that the drillers were taken somewhat unawares. The well came in with a terrific rush of oil and gas which made it impossible to get the tools out of the casing. It flowed so rapidly that in a short time the temporary sump was over-topped and the oil had reached a point a quarter of a mile or more down a ravine. It was at this place that the fire started and may very probably be presumed to have been the result of a carelessly thrown cigarette from the hands of a workman on his way to his daily labors. The blaze followed the stream of oil quickly up the ravine and almost in an instant the derrick and gusher were a seething mass of flame, those engaged in extracting the tools scarcely escaping with their lives. All the woodwork about the derrick, band wheel, shed, and engine house were soon consumed and the spot where they had stood became a veritable volcano of fire. Due either to the casing parting near the surface of the ground or to the fact of the rotary table being immediately over the top of the well forming a nucleus for excavation, a crater 50 ft. in width and some 35 ft. in depth developed within 3 or 4 days' time.

The well being on a hillside, it was thought possible that a coyote might be driven to tap the casing at a depth of 75 ft. or more, so that the pipe might be broken off at this point and at least a portion of the flow drawn through this adit, relieving the flow at the surface and reducing correspondingly the task of extinguishing the flames. The necessary surveys were made for the adit, but when the crater developed, there being no means to determine definitely just what its depth might be, the scheme was considered too hazardous and was abandoned.

The usual method of smothering by steam was then resorted to and at one time the steam from fourteen boilers was playing upon the flames. Several times they were extinguished, but for a moment only, to be rekindled by the

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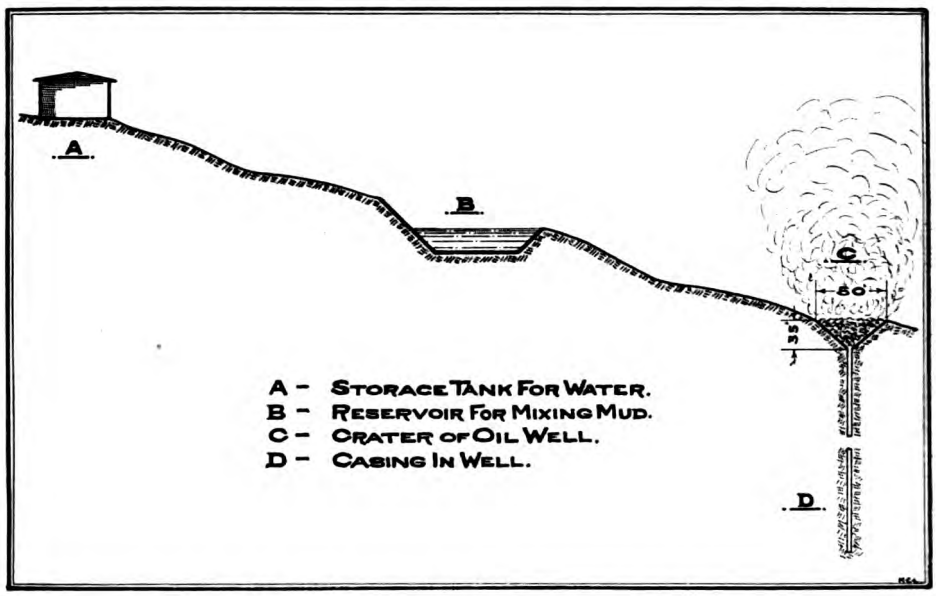
sides of the crater which, being composed of adobe soil, by this time had become baked hard and heated to a cherry-red color. Preparations were then made to try the froth method and for this purpose a 10,000-barrel steel tank was erected as near as possible to the crater for the reception of the necessary chemicals to form the extinguishing liquid. This method, however, was not tried and the tank when completed was filled with water which was used as a source of supply, (it being at a sufficient height to furnish the necessary head) for the following simple, but effective, method of putting out the fire: A reservoir, B, shown in the diagram, was constructed about 200 ft. from the well and at a somewhat higher elevation so that its contents, when desired, could be gravitated rapidly direct into the crater. This reservoir was about 50 ft. square and 3 ft. deep. In it a mixture of mud was made from the portion excavated and the surrounding adobe soil, in an amount to about fill the crater and of such a consistence that it would flow readily down the hillside into the crater when allowed to do so. This process was repeated three times and on the third application permanently extinguished the flames, the brute cooling effect of the steam formed by the drying mud being sufficient to cool the walls below the point where they would re-ignite the oil and gas.

This fire burned for 16 days and when finally conquered the well was found to be flowing at the rate of about 1000 barrels. The peculiar location of the well and the further consideration that the rush of oil and gas formed a crater, which could be filled with the mud solution, were undoubtedly salient factors in the success of this method of fire-fighting. This system might be applied in rolling country having soft shales or clay surface soils and constitutes an important addition to known methods for fighting gusher fires.



METHOD OF EXTINGUISHING OIL FIRES.

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A Suggestion for the Mines and Petroleum Exhibit, Panama-Pacific Exposition

By CHARLES E. VAN BARNEVELD *

IN just one year the universal Exposition to be held in San Francisco in celebration of the most important event of modern times, will open its doors to the world. Many people look upon the Exposition as a gigantic and expensive commercial advertising scheme. Nothing could be farther from the mark. While it has legitimate advertising possibilities from the standpoint of the exhibitor, the motif of the Exposition is primarily educational; to bring together men and women from all walks of life and from all its activities so that each may see and learn what the other is doing and how it is done. If a number of public spirited men were to get together and ask themselves: "What can we do to promote the welfare of industrial and professional America, to show our triumphs and our shortcomings, to set a mark for progress, to promote a better understanding among the nations, among the various states, among the industries"? the answer might well be—promote an international exposition. An exposition always inspires new ideas, gives impetus to inventive genius and to powers of execution, and makes for decided progress.

This Exposition will be a record of the history of the world's progress in all the arts and industries; an inventory as it were of the world's status at the commencement of this new trade era presaged by the Panama canal. Its exhibits, gathered from all over the world, will tell the casual observer, the student, the thinker, by object-lessons instead of by words, what mankind is, does, and seeks to do. It will be a living picture illustrating and interpreting the cold and bare statistics which, without such interpretation, are incomprehensible and meaningless to the average mind. It is, therefore, the privilege and the duty of each industry to properly represent its activities, each industry being in turn host to all others.

What is California's mining industry going to do, on the one hand, toward making a success of the Exposition, and, on the other hand, toward making the most of this opportunity to intelligently and attractively display its mineral resources to an audience drawn from the four quarters of the globe, and thereby uphold the prestige of the industry which has played so important a part in the development of the state?

The history of the opening, the development and settlement of the western United States is the history of the prospector and the miner. This is especially true of California. The lure of gold, following Marshall's discovery in 1848, drew to the Pacific coast the mighty throng of intrepid pioneers whose splendid achievement wrought the present western civilization, the

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climax of which is seen in the construction of the Panama canal, which has been appropriately referred to as "the greatest liberty ever taken with nature."

The great gold belt of California which stretches for a distance of 250 miles from Mariposa to Plumas, is one of the most impressive mining spectacles on earth. Since 1849 this territory has created new wealth at the rate of $2,000,000 a month. After adding over one and a half billion dollars to the purchasing power of the nation, California is still in the lead in American production.

The oil industry of California is of paramount importance to the future development of the state. The great West-side oilfields, from Coalinga on the north, stretch southward in one unbroken formation to the Midway-Sunset field, a distance of nearly 150 miles. The coast-fields occur in a stretch of territory covering four counties, within which are geologically connected areas of great productivity.

Petroleum and its products occupy a large place in the commerce of the world; in fact, no industry surpasses the petroleum industry in magnitude and diversity of operations. Capital the world over is eagerly seeking new fields. Governments realize the advantage from both a naval and a commercial standpoint of having a dependable and readily accessible supply. The continents of Europe, Asia, and the Americas have each been searched. Great areas rich in this liquid wealth have been developed. Other regions too remote from the highways of commerce of today give promise of hidden sources of oil for future generations. The world's production of petroleum has increased from 1,000,000 bbl. in 1860 to 315,178,236 bbl. in 1912. Though the industry has expanded to a degree undreamed of a decade ago, recent developments point to greater things, to new and increased demands in several directions.

Petroleum products have been of universal importance for several decades; first, in the form of refined oils, illuminants, and lubricants; next as gasoline, naphtha, etc., for use in the internal combustion engine; next in the form of crude oil as a valuable substitute for coal in the generation of steam; next as a road material; finally as crude oil for use in that greatest of modern developments in power engineering—the Diesel engine.

It is a significant fact that coincident with the joining of the Atlantic and Pacific oceans and the consequent passing into history of the "passage around the Horn," there should have arrived in San Francisco harbor the new freighter *Siam*. She neither sailed in nor steamed in, but 'motored' in under power generated by a new factor in ocean transportation—the internal combustion engine of the non-explosive type, using liquid fuel in the form of crude petroleum.

As the Panama canal has reduced a 12,000-mile voyage to 6000 miles, thus doubling the ton-mileage of vessels, so the substitution of the direct utilization of fuel against an engine piston for the indirect method hitherto in use increases the efficiency of the heat units expended about four-fold. It would seem that the day of the non-explosive, internal-combustion, marine engine has arrived. What this means to the commerce of the world is difficult to grasp. It means quadrupling the fuel-radius of a vessel; an increase of 20% in freight carrying capacity; a quartering of the fuel bill; a halving of the crew. A complete revolution in ocean transportation—and the key to the situation is crude petroleum. Fortun-

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ate is the nation that has a goodly store of liquid fuel.

California's store of petroleum is one of its richest endowments. As the premier oil producer, the world looks to this state to make such an exhibit of the industry as will mark a new epoch in its history. The evolution of the petroleum industry has been characteristically American. The past decade has witnessed most important improvements in the application of geological science and engineering to its problems, improvements in methods of production, in methods of storage and transportation, in which California has taken an important part. Our foreign confréres who have read the invitations 'to come and see,' with which we have flooded foreign lands, will take us at our word. Likewise there has been practically a complete revolution in refining practice and here we may profit by an educational exhibit of foreign equipment, methods, and products.

There are some who feel that in addition to altruistic and patriotic reasons for devoting time, thought, and money to an exhibit, they must have a good business reason. The petroleum industry of this state has been struggling under disadvantages. The public has a false concept of the industry. It knows of the large fortunes made by a few successful operators but it has failed to recognize the efforts of the far greater number who have spent their time and money in building up the industry without adequate compensation. The public, through ignorance and consequent lack of interest, has failed to provide the capital required for a proper development of the oil resources of California. It appears, however, that foreign capital fully recognizes the opportunity for investment in California fields and there is increasing danger of our industry falling into their hands. California should conserve this magnificent heritage to its own use; it should not have to pay tribute to foreign capital. The Exposition offers the oil industry an opportunity to make a collective educational exhibit which will make a lasting impression on the public mind. A thorough presentation of the questions of occurrence, production, transportation, marketing, and refining of oil, with special emphasis on the possibilities of extending the use of oil in many directions as yet dimly comprehended by the public, would be of inestimable value to the industry. It would educate the public, remove ignorance and prejudice, it would stimulate public interest, public co-operation and investment. The need of fostering this industry by wise legislation would be brought to the public's attention. Much good would undoubtedly come in the way of stimulating experimentation and inventive genius by directing thought to petroleum and its uses.

Many states in the Union point to a much larger mineral production than can California, but none can point to a combination of like potential value. California is the leader among this nation's gold producers, creating yearly $20,000,000 of new capital. California is the leader in petroleum production, with about 40% of the American production, about 25% of the world's production; the heaviest producer among the states of the Union by over 60%, exceeding the output of the heaviest foreign producer, Russia, by over 40% (1912). Not only does California, through its vast oil resources, command an abundance of cheap fuel which is an aid to transportation, mining, agriculture, and horticulture, and a stimulus to manufacturing industries, but the lighter California oils have a great potentiality as raw material for

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many lines of manufacture as yet undeveloped.

It would seem as though an industry of such magnificent proportions and of such state-wide importance should do something more than have a series of unrelated county displays. It is entirely proper for the counties to wish to make a display of their various resources, agricultural, horticultural, forestry, mineral and oil, etc., in the California Counties building. Each county can thus draw attention to what it has to offer the investor and the homeseeker in each line. Such an exhibit has its rightful place; it is, however, merely an exhibit of mineral resources and very far from being an industrial mining exhibit, which latter is a graphic portrayal of the mining industry, without which the mineral exhibit would be flat and unprofitable. The exhibit which impresses the public and teaches the valuable lesson is the complete exhibit which begins with undeveloped mineral resources, ends with the article sold to the retail trade of the country, and shows, in so far as possible, intermediate processes. The public must be educated regarding the importance of the mining industry. The right kind of an industrial exhibit will teach them the lesson in co-operation which they need. They do not realize the problems of the industry, its need for public support and co-operation. A beautiful collection of mineral and ore specimens or a well lighted and well arranged collection of crude and refined oils, attracts the color sense, the sense of the artistic and very little else, unless it forms a link in the complete exhibit of the industry. The mining man who knows all about mineralogy, about ores and their occurrence, is interested in these mineralogical exhibits because he has the supplementary information needed to make the exhibit instructive. The thousands who know little or perhaps nothing about the details of mining see in it something pretty and attractive, but it does not teach them a lesson. An exhibit which does not teach a definite lesson is a waste of money and effort on the one hand, a waste of valuable space on the other.

The proper place for California's mining and oil exhibit is unquestionably the Palace of Mines and Metallurgy—in a mining atmosphere, in competition with the mining exhibits of the other states and nations. There is where the world will expect to find it, and unless it is made there, the world will not see it. Everyday life teems with illustrations of the value of co-operation and united effort in a common cause. The oil industry of the state, including as it does production, transportation, refining, manufacturing, and export, on a tremendous scale, is far greater than that of even the leading producer among the counties. Then, aside from questions of the right kind of public spirit, industrial and state pride, would it not be good business policy to draw the world's attention to the greater? A county would unquestionably derive more individual benefit from a comprehensive, well worked out, complete state exhibit of an industry than it would derive from the same amount expended on an individual exhibit. This is merely another striking case where co-operation will bring results which can not be secured in any other way. Furthermore, the counties need not lose their identity under this plan. There are other, more dignified, more effective ways of attracting attention to a county's position than by needless duplication of exhibits; further mention of this is made under the head of 'suggestions for California's petroleum

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exhibit.' The counties could at best make relatively small individual exhibits of minerals, ores, and oils supplemented by photographs, maps, and an occasional model. There would be quite an array of these individual exhibits and much inevitable duplication. Such exhibits are tiresome to the visitor who has heard much of California's wonderful mining history, they are disappointing to the visitors from other states, and from all over the world, who have come to see and learn something about the mining industry. Collectively, the industry can make an exhibit which will be spectacular, beautiful, instructive, and which will impress the world with the importance of the mining industry of the state and therefore with the importance of the mining and oil producing counties. That is what the state wants and what the counties want. Unfortunately no funds have been provided for a state exhibit. To remedy this deficiency I suggest that the counties unite in financing such an exhibit out of the exposition funds which they are raising by taxation.

Plan for a Collective California Mining Exhibit

In the centre of the Palace of Mines and Metallurgy, under the dome, which towers to a height of 160 ft., is a space of 150 by 200 ft. The main aisles from the four entrances to the Palace converge toward this space so that it naturally divides itself into four quadrants, each one opposite a main entrance. This is the choicest space in the building and I would like to see placed in it a mountain having a peak of 45 to 50 feet. Each quadrant of this mountain, facing a main entrance to the building, would be finished to represent some main sub-division of the industry. One of these could represent an important oilfield reproduced in such detail as to give a comprehensive idea of California's wonderful oil industry. Another a placer mining section to include primitive methods, a reproduction of the La Grange mine with giants throwing streams of 20 to 25 ft. in length, and at the base of the mountain a working model of a dredge showing all operations in detail. Another section could show the copper industry. The fourth side could be devoted to the representation of quartz mining. Several veins might be shown, one being prospected with the meager equipment characteristic of prospecting work, another fully developed, producing, and fully equipped. A section of the mountain could be cut away here and behind a plate-glass front the underground working details could be shown.

Such an exhibit would, on account of its prominent position, visible from each of the main entrances, on account of its completeness, its unique features, its very boldness, surpass anything in the building and would make California's exhibit the centre of attraction. The expense, viewed in the light of its being the exhibit of an industry which in one year produces over $90,000,000, would be relatively small. It would have a tremendous stimulating and otherwise beneficial effect on the industry. The state's debt of acknowledgment to the pioneer miner would be complete. The miner's pride, his community pride and his industrial pride would be satisfied. The natural resources of the counties could be exhibited in the space surrounding California's mountain in a setting such as no other state could approach.

The cost of the central exhibit would be roughly $75,000. The mineral and oil exhibits from the various mining counties would cost perhaps another $75,000. This plan insures the best

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state and the best possible counties display at the least cost and under conditions where each one's exhibit re-enforces and is re-enforced by his neighbor's exhibit. Each county might rightfully say, "This is our mountain." The quartz counties could exhibit opposite the quartz section of the mountain; the placer mining counties opposite the placer section; Shasta county opposite the copper section; the oil producing counties individual exhibits would be deployed in magnificent array around the oilfields. If this plan is carried out the mineral industry of California will present a solid front, will be the centre of attraction, and, best of all, the various natural subdivisions of the industry and the individual counties will maintain their individuality.

Suggestions for California's Petroleum Exhibit

1. Relief model showing geology and developments of the West-side fields of California, on a scale of 3 in. to the mile, which would make the length of the model roughly 36 feet.

2. Relief model; same scale as above, of the Los Angeles-Orange counties fields.

3. Model to a large scale of a typical producing anticlinal fold in the Ventura district.

4. A transparent model of "35 Anticline" based on well-logs and surface evidence; scale, 3 ft. to the mile.

5. A collection of rocks and fossils typical of the oil-bearing formations of California.

6. A series of models in wood, iron, and glass, to show the oil and water formations and their relations to the topography and to the containing shales.

7. A glass model (to scale) of certain oil wells, showing all casings mounted in actual formations, with water percolating through the water sands and oil being extracted from the oil sands.

8. The effect of the encroachment of water on an oilfield might be shown by models.

9. A collection of maps, cross-sections, photographs, graphic statistics as to production, illustrating the various fields by counties.

10. An educational exhibit of oils properly lighted by transmitted and reflected light, showing complete line of crude oils, based on gravity, from tar to highest natural crude. A compact suite of small samples should be arranged to illustrate the refined products from each type of crude oil.

11. Storage, pipe-line, and transportation exhibits, connecting the oilfield to a model of a refinery on the seaboard.

12. Exhibits by the refineries of their manufactured products.

The foregoing is to form one general exhibit from the oil-producing counties and to surround the oilfield quadrant at the mountain. By properly marking off the counties on the relief models, and furthermore, by carefully maintaining the individuality of each county in the exhibits under heading No. 9, the counties would not lose their identity in this collective exhibit, duplication would be avoided, and a much more valuable and educational display of the industry would result.

Operating and Refining Exhibit

The major exhibit of the petroleum industry, to consist of well-drilling, oil-refining, and oil-testing, supplemented by exhibits of the actual utilization of the different cuts from the refinery in the various machines for which they are best suited, must be made in the Oil camp, which will be adjacent to the Gas and Fuels building. Here it is

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hoped, all the following activities will be shown in full blast:

1. Model oil-camp.

2. The drilling of a well with complete standard and rotary drilling equipment, a full line of tools, the equipment for handling high pressures and large flows of gas and oil, also equipment for conserving oil and gas under low pressures and small flows.

3. Exhibits of special tools and appliances.

4. Models of field storage and transportation equipment.

5. A compressor installation showing method of producing gasoline from natural gas.

6. A working model of an electric water-oil separator showing Cottrell process of continuous extraction of water from emulsified oil.

7. A small refinery consisting of a battery of say 10 stills, of 50-gallon capacity each, to illustrate the most modern method of continuous oil distillation.

This distilling plant running continuously will produce upward of 15 cuts. One of the most instructive and interesting features of the exhibit will be the demonstration of the proper use of each product.

Gasoline may be shown applied in its proper sphere.

Gas Oil may be converted into domestic gas and fuel by gas producers with subsequent utilization of domestic gas in lamps, gas ranges, etc., and of fuel gas in driving a gas engine.

Heavy Naphthas may be shown burning directly in a heavy-naphtha or kerosene carburettor, a recent development of the automobile business, which promises to be of the utmost importance.

Fuel Oils may be shown in oil burners under boilers. The heavy fuel oils would be shown feeding Diesel engines, stationary, marine, and locomotive.

Petroleum Products may be shown in all their variety and, in so far as possible, in actual use in their proper field.

Asphaltum Residues may be shown in use in actual paving or street construction.

8. Methods of treatment may be shown, including washing and purification methods.

9. There should be a modern testing laboratory to show the most approved equipment and the latest methods used in scientific testing. In this research laboratory certain kinds of investigation work could be carried on during the entire Exposition period.

10. It has been suggested that 5-gal. samples be obtained of each of the products from the various refineries of the United States; also of the crude oil from which these products are obtained; standard size samples to be exhibited and the balance used for a critical scientific examination to be made in the testing laboratory. A card giving the chemical composition, physical characteristics, and commercial properties of each sample exhibited could accompany the sample. It is thought that if such examinations and tests are properly made under the direction of some competent and disinterested agency such as, perhaps, the United States Bureau of Mines, they will form the basis for important comparative information which would have scientific and commercial value.

The foregoing suggestions have come from various sources; they are here presented in the hope that they will inspire prompt and united action leading toward an exhibit which will be a credit and a benefit to the mining and oil industry of California.

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Refrigeration Process for the Manufacture of Gasoline From Casing-Head Gas

By CHARLES T. HUTCHINSON

THAT increased attention is being paid to the utilization of hitherto waste products in the California oilfields is shown by the number of new plants recently installed for the manufacture of gasoline from casing-head gas. The latest plant for this purpose is that of the Olinda Gasoline Co. at Olinda in the Fullerton field, about 27 miles from Los Angeles. Heretofore the process involved provided for the use of two-stage high-pressure compressors, inter-cooling and after cooling, using pipe coils cooled either by air or water and a tank for receiving the condensate. The process used at Olinda was devised by George F. Vordermark and differs in many respects from the ordinary methods in vogue. Mr. Vordermark utilizes artificial refrigeration obtained with an ordinary ice machine in place of high compression of the gas followed by expansion and water cooling, and claims to obtain thereby a much higher percentage of extraction at a reduced cost both of operating and initial plant expenditure than could be obtained by the former method.

The gas treated at Olinda is the product of the Amalgamated Oil Company's wells and the pressure at the wells is not sufficient to cause it to flow naturally through the gas mains to the treatment plant. This is a favorable indication of high gasoline content, however, as it is well known that gas coming from wells under high rock pressure carries a very small quantity of the lighter oil fractions with them.

The plant consists briefly of the following:

One 30-ton capacity York ice machine, consisting of a 2-cylinder, 10½ by 15, ammonia compressor, vertical type direct driven by a tandem compound non-condensing horizontal Corliss engine $\frac{14 \times 26}{15}$ operating at 86-90 r.p.m.

Two 100-hp. horizontal return fire tube boilers operating at 125-lb. pressure and fired with natural gas. One boiler is operated continuously and the other held in reserve.

One horizontal jackshaft driven by belt from the fly wheel of the ice machine engine and including friction clutch pulleys for driving the gas pumps and for the usual auxiliaries.

Two gas pumps. These are single horizontal Laidlaw Dunn Gordon belted compressors built for 100-lb. working pressure. The cylinders are 14 by 12 and the speed averages 184 r.p.m. These machines maintain ½ in. of vacuum in the gas main from the well, drive the gas through the gasoline condensers or stills and send the dry gas into the gas-return mains at 40 to 50-lb. pressure.

One Gould vertical triplex belted boiler feed pump 2½ by 4 inches.

One 1½-in. centrifugal water circulating pump for handling the jacket cooling water between the compressors, ice machine, and cooling tower.

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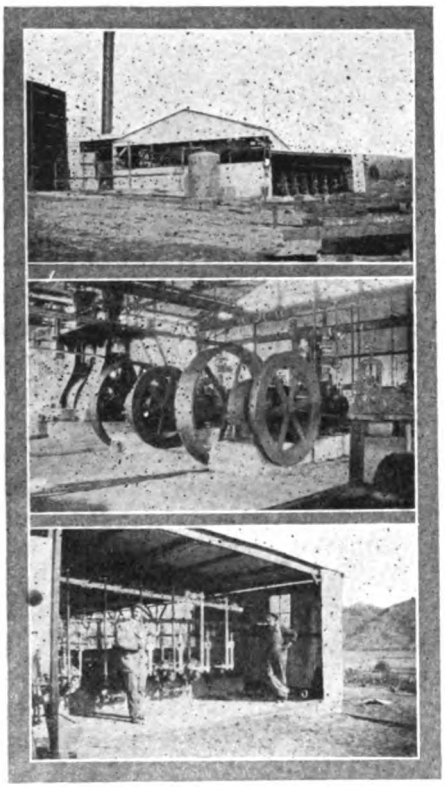
One gas receiving tank 6 by 10 feet.

Seven gasoline condensers or stills. Each still is made of 12-in. black pipe 80 ft. long with cast iron heads, glass gauges, and drain cocks. Each still contains an ammonia coil consisting of 1260 ft. of 1¼-in. pipe connected by return bends. The pipe connections between stills are so arranged that the



EXTERIOR OLINDA GASOLINE PLANT.
INTERIOR, SHOWING COMPRESSORS.
END VIEW OF CONDENSERS.

stills are connected in series and also that both gas and ammonia may be diverted so that any still, or stills, may be disconnected at any time without discontinuing operations.

Two gasoline collecting or storage tanks 6 ft. diameter, 2 ft. long, 4400 gallons capacity each.

One ammonia condenser consisting of 3 coils of 2-in. pipe, 8 lengths in each, 20 ft. long with return bend connections.

The ammonia gas is drawn from the container by the ice machine through an expansion valve into the stills. It is then compressed and sent through the ammonia condenser into an 8 in. by 12-ft. receiver which is connected to the ammonia container so that either may be used as a source of supply. The ammonia gas is thus circulated continuously until the supply has been exhausted and a new container installed. The plant has been in operation since September 1 and while the first container of 128-lb. of ammonia has not yet been entirely consumed, it has been calculated that for continuous operation under full capacity 2 drums of ammonia should serve for 3 months' operations.

The course taken by the gas from the well may be briefly described as follows: Through a 6-in. main into the 6 by 10-ft. receiver. From thence through a 6-in. main with 5½-in. branches to the gas pumps. From the gas pumps to the gasoline stills, the dry gas going to the return pipe main and the gasoline condensate to the receiving tanks.

It was discovered as soon as operations were commenced that sufficient engine power had not been provided. Orders have been placed for two steam-driven compressors to replace the two belt-driven machines. In the meantime the plant is being operated with one compressor only. This machine is handling 251,000 cu. ft. of natural gas per day of 24 hours from which an average of 1000 gallons of gasoline is extracted which has a Baumé gravity between 60 and 90°.

All conditions governing the operation of this plant make for unusual economy. Natural gas is burned under the boilers and for which no charge is made. Two 12-hour shifts are worked

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per day of 24 hours. Three men in all are employed, one man on each shift and a superintendent in charge. Practically all of the gasoline is drawn from the first four stills, in the first two of which no refrigeration is used. According to R. O. Wrana* one of the most advantageous features of the new process is in the possibilities afforded by the faculty whereby the degree of refrigeration may be regulated in each still to condense any given liquefiable hydrocarbon. Thus one may fractionate the mixture of hydrocarbons by successive refrigeration.

The gas after passing through this process is practically dry. The gasoline showed on analysis to contain 30% of pentane, 30% hexane, traces of butane, and the rest hexane and higher hydrocarbons, less than 7% of hydrocarbons under 50° Baumé. The loss in evaporation in a common gasoline container was less than 2% when 78° gasoline was tested, 5 to 7% loss when 86° was tested. The 86° Baumé gasoline contains a good proportion of petroleum ether. The wells producing this wet gas of a density of 0.964 to 1.04 produce an oil of from 30.9 to 35.4° Baumé. Mr. Wrana has given the following comparative results of distillations made in cuts of 10% each of the gasoline produced by refrigeration, common condensation, and distillation from crude oil.

(A) Gasoline by refrigeration, 79.4°B.
(B) Gasoline cond. in pipe-line, 60.5°B.
(C) Gasoline from crude oil, average 60°B.

	(A)	(B)	(C)
1. Pentane predominating	92.4	74.6	75.2
2. Pentane predominating	92.4	68.3	68.1
3. Pentane predominating	90.8	64.4	65.1
4. Hexane predominating	85.8	61.9	63.2
5. Hexane predominating	81.2	59.6	60.1
6. Hexane predominating	76.6	58.5	59.5
7. Commercial gasoline	69.2	57.0	56.0
8. Commercial gasoline	60.0	56.2	54.6
9 and 10. Commercial gasoline	55.0	51.6	50.7

In order to determine the comparative qualities of different gasolines, tests were made of three grades and the following will give comparative results of distillations made in cuts of 10% each of the gasoline as produced by refrigeration, common condensation, and distillation from the crude oil.

These distillations are made in 10% cuts to obtain a comparison of the three different kinds of oil. The gasoline condensed in the pipe-line was of a black color from dirty pipes and it was not known to Mr. Wrana how long it stood exposed to the air. On a careful redistillation it did not show any pentane, the first fraction being totally composed of hexane (ethylisobutyl).

An analysis of the gasoline made from the average run of crude oil showed on fractional distillation ethyltrimethylmethane.

*The Oil Age, September 26, 1913.

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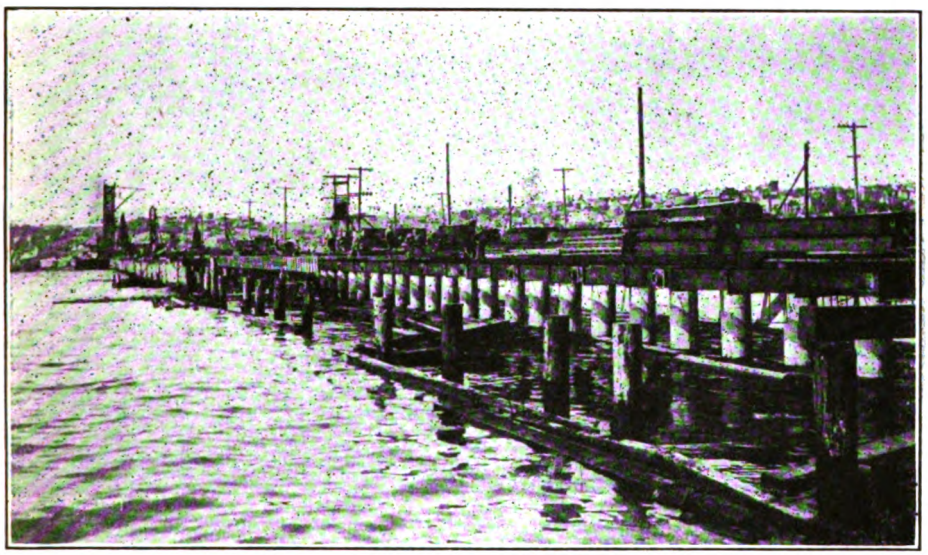
Port of San Diego

By EDWIN M. CAPPS*

IT is the universal opinion among mariners that the port of San Diego is one of the finest natural harbors in the known world. Situated in a zone of perpetual summer, free from storms, insidious currents, or rock-bound coast, it is at all times a haven of perfect security. The entrance is of ample width, is remarkably easy of access, and has a minimum depth of water of 31 ft. at low tide. The channel inside is from 1300 to 2000 ft. in width, with water ranging from 35 to 70 ft. in depth at low water, while the bay is of generous proportions, being 22 square miles in area. It is not so large that wave action is a menace to shipping or harbor improvement; waves greater than 3 ft. being most unusual.

The general contour of the bay is ideal, and the bold headland, Point Loma, seems to have been placed by the hand of the Creator for the purpose of protecting this magnificent bay from the prevailing northwest winds, and to further provide formidable natural advantages for fortifications second to none. Its location geographically is conspicuously favorable. This is especially evident since the building of the Panama canal. By inspection of a terrestrial globe it will be seen that San Diego bay is on the arc of a great circle which passes through the westerly end of the canal, and through China, Japan, and the Philip-



SEA WALL AND PIER UNDER CONSTRUCTION.

*Harbor Engineer, San Diego, Cal.

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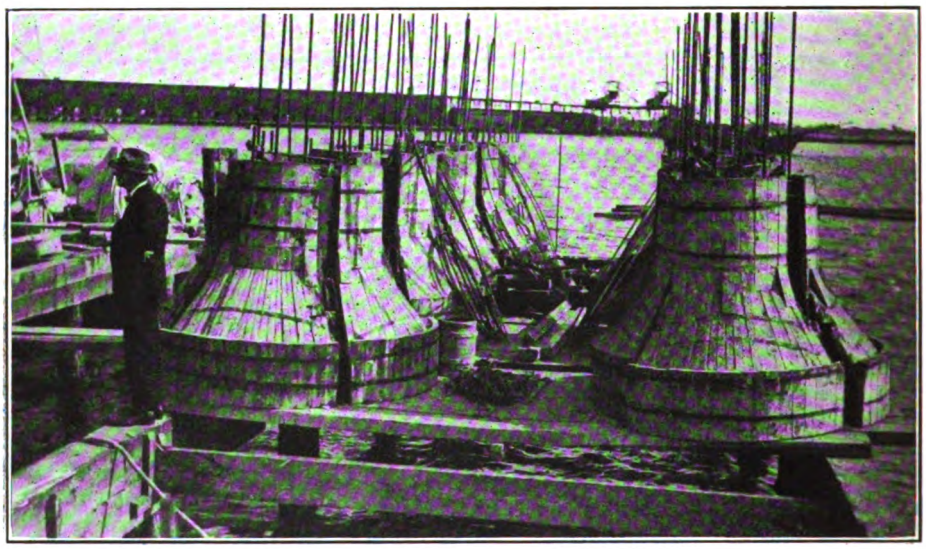
pines. It is, therefore, the first and last port of call on American territory for all ships bound in or out of the canal, and its importance, due to its location, is very apparent. From this fact alone it is destined to become a port of the first magnitude.

The bay of San Diego is probably unsurpassed in its natural conditions, not only for economical construction, but for upkeep as well. The floor of the bay is of such a character as to present a firm foundation for harbor improvement at economical depths, and at the same time yields readily to dredging at a minimum cost. No fresh water streams discharge into the bay, consequently when once dredged, this work is practically completed and the chief source of expense in harbor upkeep, continual dredging, is here eliminated. The tides are nominal, being about 5 ft. on an average.

The confidence in the future greatness of the port is best shown in the character of the harbor improvements now under construction. No expense has been spared to construct the best and most substantial improvements known to modern engineering. These improvements consist of one pier 130 ft. in width and 800 ft. in length, 2675 lin. ft. of bulkhead wharf, and the reclamation of about 60 acres of tide lands. Both the pier and bulkhead wharf are constructed entirely of concrete and steel, and are thus proof against the elements or the ravages of marine insects. The pier will be provided with four standard-gauge railroad tracks, two on each side, and for the temporary storage of cargo a substantial steel warehouse will be erected upon the pier. This warehouse will be 72 ft. clear span, and 750 ft. in length, and will be provided with steel roller doors, skylights, and ventilators, all in accordance with the best modern practice. This pier will be supported upon 540 reinforced concrete piles, each 3 ft. in diameter and reinforced with 13 bars ¾ in. square, specially wound 6-in. centres with No. 0 wire. These piles are of the splay bottom direct



FORMS FOR SPLAY BOTTOM PRECAST PILES BEFORE REMOVAL.

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bearing type, and are constructed and placed into position substantially as follows:

1. The splay bottoms as shown upon the drawings are made in suitable wooden forms and permitted to harden for not less than seven days before using.

2. The steel caisson is placed on the bottom of the bay and concentric with the pile point, it is then jetted or driven down until its lower end is at the ultimate depth of the pile proposed to be used. The earth from the inside of the caisson is removed either by the use of overflow jetting or by an orange peel dredge bucket.

3. Construct a temporary wooden platform on top of the steel caisson, place one of the previously prepared splay bottoms on top of this wooden platform, and connect up the reinforcing bars in the stem of the pile with the protruding bars from the splay bottom, using suitable wire rope clips and gas pipe sleeves as indicated. Wind the splice with No. 0 wire to conform with the spiral winding of the pile, then house the wooden jacket down over the neck of the splay bottom and cinch up the steel bands as shown.

4. Take hold of the four staples in the splay bottom with a bridle, hoist the whole combination of splay bottom, wooden jacket, and reinforcement clear of the temporary wooden platform, remove the platform, and lower down on the inside of the steel caisson, filling the inside of the wooden jacket through openings made in the side of the wooden jacket as the pile descends, closing and caulking these openings as they pass below the water line, the surface of the concrete on the inside of the wooden jacket being kept at all times below the surface of the water outside. As the splay bottom approaches the desired depth the jets are set at work and the remaining earth on the inside of the steel cylinder is agitated sufficiently to permit the proper seating of the pile, after which the steel cylinder is drawn up, permitting the neighboring sand and earth to close in and freeze the pile solidly in place. The steel caisson is then again placed in a similar manner for the reception of the succeeding pile.

The superstructure or deck is composed of a grillage of structural steel I-beams encased in concrete to prevent corrosion, a reinforced concrete slab 6 in. thick, and a cushion of asphalt 3 in. thick. The depth of water alongside the pier will be 35 ft. below lower low water, providing 1600 lineal feet of deep sea berth room.

The bulkhead wharf consists of a gravity type seawall, with combination wood and reinforced concrete supporting piles. The apron consists of structural steel I-beams encased in concrete with reinforced concrete slab and asphalt cushion. When completed it will develop 2545 lin. ft. of berth room with a depth of 20 ft. below extreme low water.

Other details with regard to the construction of the bulkhead and pier may be briefly summarized as follows:

Bulkhead.—The retaining wall proper is made of reinforced concrete and is 29 ft. high, 10 ft. wide on the bottom, and 3 ft. wide on the top. The foundation below the retaining wall consists of a cluster of wood piling, 4 piles in width, spaced 27 in. centres, and extending the entire length of the retaining wall spaced 3 ft. 6 in. centres. The floor supporting structure is a series of combination reinforced concrete and wood piles spaced 13 ft. 4 in. apart. The fender pile construction consists of a series of 14 in. piles spaced 3 ft. centres, the lower end being driven into the mud and the upper end being at-

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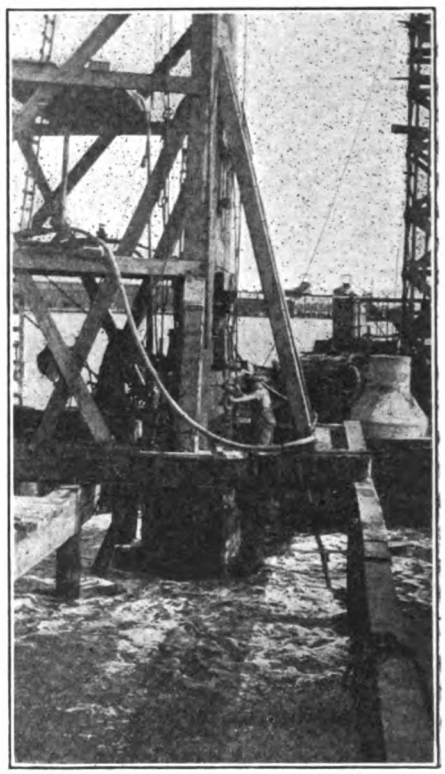
tached to the deck beams by means of through bolts and car springs to take up the jar due to impact of vessels. The deck beams consist of a series of 20 in. 65-lb. I-beams approximately 25 ft. 3 in. long and set 6 ft. 8 in. centres. Reinforced concrete floor slab is used, protected by an asphalt wearing surface.

The usual specifications for broken stone, sand, reinforcing and structural steel were employed. Asphaltic cement was specified to be a mixture of a refined liquid asphalt and a refined solid asphalt, or to be an oil asphalt and free from admixture with any residues obtained by the artificial distillation of coal, coal tar, or paraffine oil. The limits between 60 and 70° penetration by the District of Columbia standard were specified. The mix used for floor slab and concrete envelopes for structural steel and in the supporting piles was one sack of portland cement, to 2 cu. ft. of sand, and 4 cu. ft. of crushed stone. The mix used in the construction of the concrete retaining wall was one sack of portland cement to 3 cu. ft. of sand, and 5½ cu. ft. of broken stone. The asphaltic wearing surface was composed of asphaltic cement, fresh-water sand, lime dust, or portland cement, in detail as follows. Bitumen soluble in carbon bisulphide between 10 and 13%; sand, stone dust, and other inorganic ingredients between 10 and 14% to pass a screen of 200 mesh; between 20 and 28% through an 80-mesh screen and on a 200-mesh screen; between 20 and 26% through a 50-mesh screen and on an 80-mesh; between 18 and 24% through a 30 and on a 50-mesh screen; between 4 and 8% through a 20 and on a 30-mesh screen; between 2 and 5% through a 10 and on a 20-mesh screen; between 10 and 18% of the wearing surface mixture should consist of lime stone dust or portland cement.

The sand was heated in dryers to a temperature between 300 and 370° F. The hot sand and cold stone dust were then thoroughly mixed together in a mixer, the necessary quantity of asphaltic cement previously heated to between 250 and 300°F. is then added,



JETTING STEEL CAISSON.

and the whole thoroughly mixed until every particle is coated with a thin layer of asphaltic cement. The surface mixture was transferred from a mixer and covered with a heavy duck tarpaulin to prevent cooling. It was uniformly spread over the floor slab with hot shovels and hot rakes to the required thickness. The initial rolling is done by a hand roller weighing not less than 20 lb. to the lineal inch width of tire. The finishing compression is done by a steam roller weighing not

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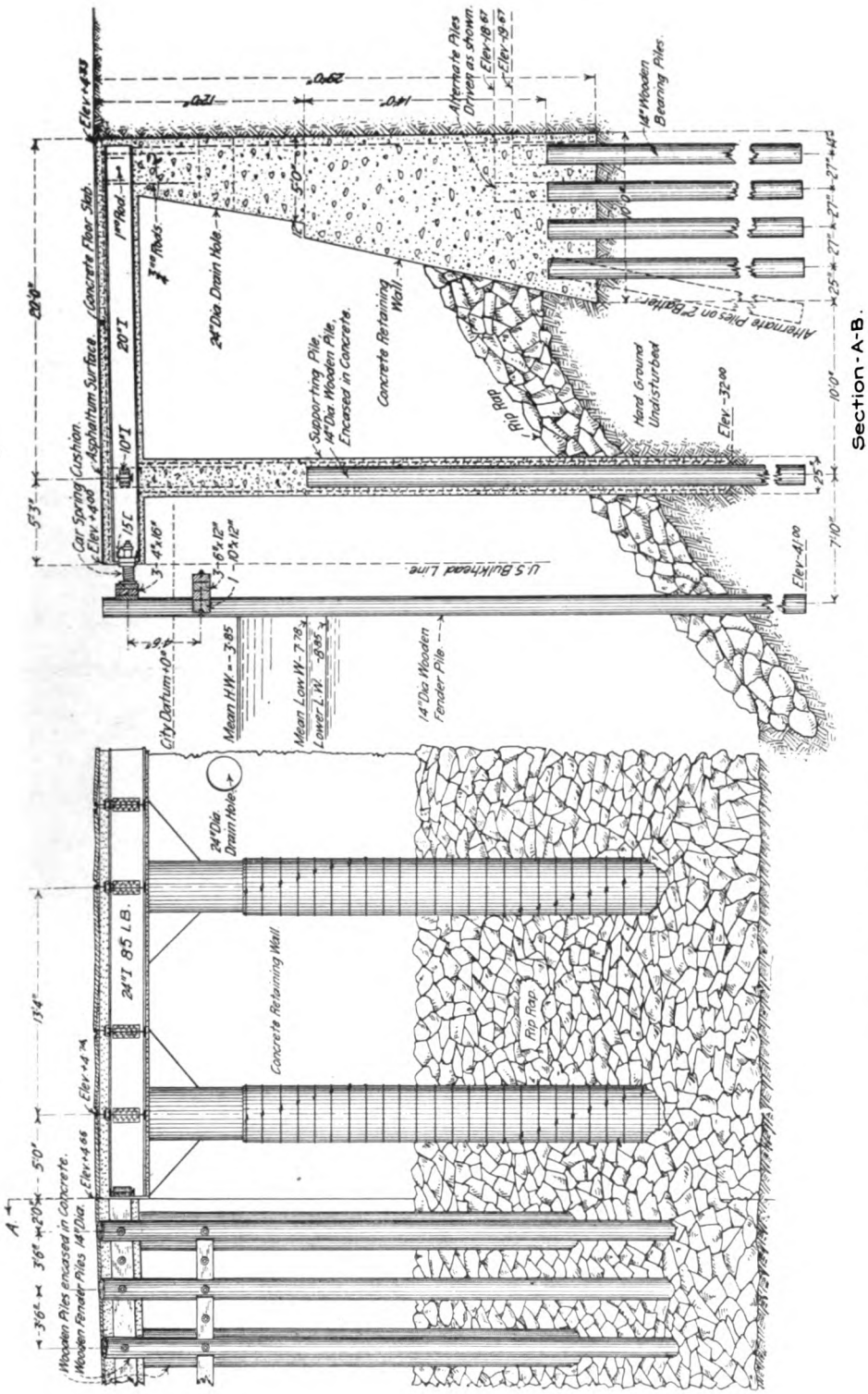

DETAILS SHOWING BULKHEAD AND FENDER PILES, SAN DIEGO HARBOR.

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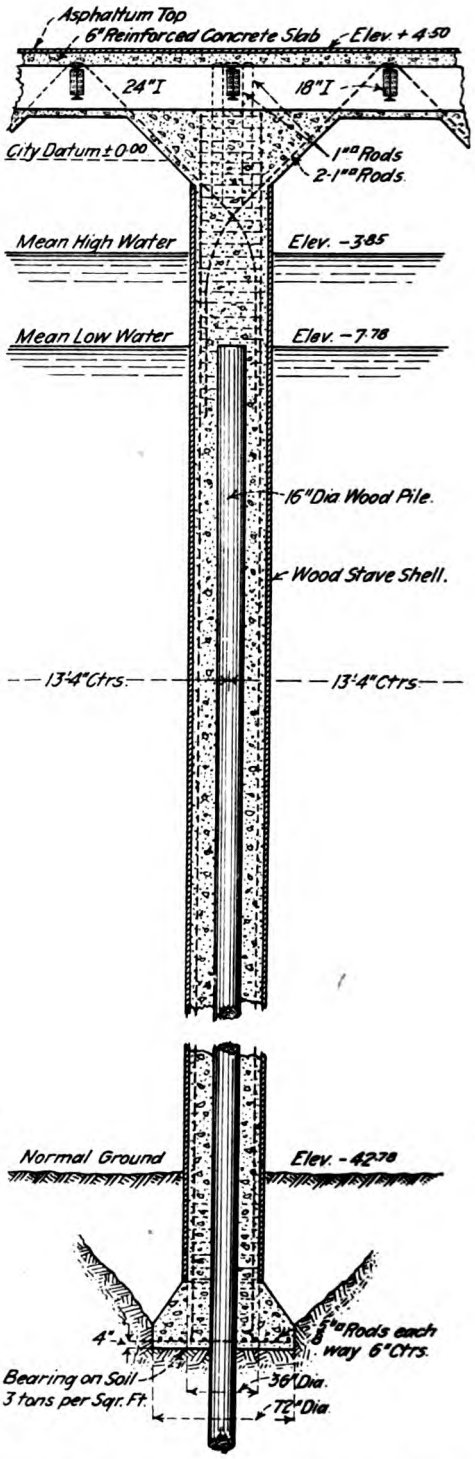
less than 5 tons. The latter rolling was continued for a period of not less than 5 hours for each 1000 square yards of pavement, after which a small amount of hydraulic cement, or infusorial earth was swept upon the pavement.

The combination wood and reinforced concrete supporting piles consist of a 14-in. wooden pile core, driven down to a 27-ton safe bearing load. This was determined by the drop of a 2000-lb. hammer for a distance of 20 ft. with a penetration of ½ in. for each of the last 5 blows of the hammer. After driving, the top of the wooden pile was sawed off with a square head at mean low water mark. These wooden piles were sheathed with a reinforced concrete sheathing as shown in the illustration. The sheathing was made in the open air in moldings and over forms and allowed to thoroughly harden and cure for 30 days before being placed in position. The sheathings were then placed over the wooden piles and jetted down to the position required. At the time of manufacturing the sheathing, the vertical reinforcing bars were allowed to extend upward for at least 4 ft. to permit of continuing the concrete work of the pile up to the point where the superstructure begins. The sheathing was made of a 1:2:4 mixture of cement, sand and broken rock and provides for an annular space between the wooden pile and the concrete sheathing of not more than ½ in. thickness at any point. The rock used for riprapping consisted of pieces ranging from about 1 cu. ft. to about 5 cu. ft. No boulders or cobbles were used.

Pier—The new pier is approximately 800 ft. long and 130 ft. wide. The supporting structure consists of a series of reinforced concrete piles set 15 ft. centres longitudinally and 13 ft. 4 in. laterally. Wooden stave cylinders 3 ft. inside diameter and 2 in. thick se-



SECTION OF SPLAY BOTTOM COMBINATION PILE.

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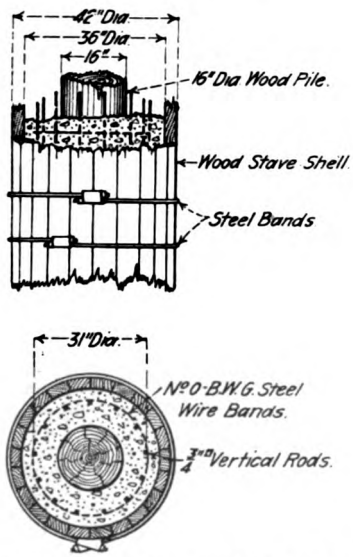
curely banded were used for forms in the manufacture of the concrete piles. These cylinders were left in place when the piles were driven. The piles themselves were of the combination wood and reinforced concrete type in general similar to those used on the bulkhead construction.

The fender piles used were 60 ft. in length and ribbed in the usual manner with two tiers of ribbing, the lower



PLAN AND ELEVATION, COMBINATION PILE.

consisting of 3 pieces of 6 by 12-in. timbers and the upper of 3 pieces of 4 by 16-in. timbers. Car springs were used for cushioning as in the bulkhead construction.

The city is the owner of two hydraulic dredges, one 18 in. and one 12 in., and is doing its own dredging. About 1,700,000 yards of earth will be moved under the present improvement. The total aggregate cost of the improvements will be $1,000,000, which will be divided about as follows:

Pier complete	$ 400,000
Bulkhead wharf	360,000
Dredging	180,000
Incidentals	60,000
	$1,000,000

All the work is now in course of construction, and about 25% is completed. By an act of the State Legislature in May, 1911, the city was granted absolute control of its water front, and the tide lands adjacent. This grant was made upon the condition that $1,000,000 be expended in harbor improvements within three years from the above date. The work under construction is in compliance with this condition. The tide lands embraced in this grant aggregate 1460 acres, the whole of which is now the property of the city, and constitutes its entire water front, a distance of about 10 miles in length.

The reclamation of these lands will be made by the continual operation of the municipal dredges, and will constitute a potent factor in liquidating the expense of harbor upkeep, making possible a practically free port.

The tentative plans for the ultimate improvement of the harbor contemplate piers 1000 to 1500 ft. in length, 130 ft. in width, and slips of 250 feet. With this arrangement, the ultimate berth room will total 30 miles, or ample accommodation for 27,000,000 tons annually.

All railroad traffic upon the reclaimed tide lands will be handled by the city, over its own tracks, and with its own engines.

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The Engineering Digest

Centralized Control System for Panama Canal Locks*

THE electrical specification, design, and manufacture of the Panama canal centralized control system may properly be regarded as one of those undertakings which, from an engineering standpoint, not only arouses a lively interest, but also presents an opportunity for much valuable instruction. The interest results mainly from the immensity of the canal project itself, and the instruction from a consideration of the methods employed to insure the passage of even the largest ships afloat across the isthmus with speed and safety. The complete operation of the canal locks, terminals, and auxiliary equipment utilizes electrical energy throughout, with the present exception of the Panama railroad, the electrification of which is under contemplation.

The specifications for the entire generating, lock controlling and distribution system for operating the Panama canal were prepared under the supervision of Edward Schildhauer, Electrical and Mechanical Engineer, Isthmian Canal Commission, assisted by a staff of electrical engineers, including C. B. Larzelere, who was closely identified with the lock control problems, and W. R. McCann with the generation and distribution of power. These specifications exhibited great care and painstaking engineering. They contained every safeguard that expert engineers could suggest, were exact and explicit in regard to the results required, yet gave proper range in the details of accomplishment.

Generation and Distribution

The power system for the operation of the locks, towing locomotives, lights for the locks and buildings, and motors not directly connected with the lock control, is composed of:

A 75,000 kva. 2200 volt hydro-electric power plant at the Gatun dam;

A 4500 kva., 2200 volt Curtis turbo-generator electric power plant at Miraflores for emergency, lately used to supply power for construction work;

A double 44,000 volt transmission line across the isthmus, connecting Cristobal and Balboa with the two power plants;

Four 44,000-2200 volt substations, stepping down at Cristobal and Balboa, and up or down at Gatun and Miraflores, depending on which of the two plants is supplying power;

Thirty-six 2200-240 volt transmission stations for power, traction and light at Gatun, Pedro Miguel and Miraflores locks;

Three 2200-220-110 volt transformer stations for the control boards at the locks;

Stations at Cristobal and Balboa for coal handling plants, machine shops and dry docks.

The system of connection throughout employs a double bus, double switch scheme, with provision for disconnecting any oil switch for cleaning or repairs without interrupting the circuit. In the power house and the four 44,000-2200 volt substations, the oil switches are solenoid operated and are installed in concrete cells, above which are concrete fireproof compartments containing the two sets of buses. In the thirty-six transformer stations in the lock walls, the oil switches are hand operated. All 2200 volt oil switches have disconnecting switches, so arranged that live parts are completely covered.

For the hand operated switches, a pipe framework supports vertical metal guides which carry the oil switch operating mechanism and slate base forming a section of the switchboard panel. On the guides a lever and toggle mechanism is mounted, by which the oil switch and slate base may be raised and lowered. Above the oil switch and mounted on the pipe framework a stationary

*Data contributed by General Electric Company.

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cast-iron base carries the disconnecting switch studs and insulators. The high tension leads run to the tops of the disconnecting switch studs, and the bottom of each stud is equipped with contact fingers. On the top of each oil switch stud is mounted a contact blade. When the oil switch is raised, these blades engage the contacts on the bottom of the disconnecting switch studs, which thus in the closed position form extensions of the oil switch studs. The disconnecting switch contacts are surrounded by insulating shields which prevent accidental contact. When the oil switch is lowered, it is completely isolated from the circuit. When the oil switch is raised, it always goes to a fixed height where it is latched. An interlock prevents the oil switch from being raised or lowered unless its contacts are open, precluding the circuit being closed or opened by the disconnecting switch. In some instances another interlock makes two single-throw switches a double-throw switch and prevents both switches being closed at the same time.

For solenoid operated switches, the same form of disconnecting switch is used; but the solenoid is stationary and the connecting mechanism to the oil switch has a vertical slotted link which allows the oil switch to be raised and lowered without being disconnected from the solenoid mechanism. A mechanical interlock prevents the raising or lowering of an oil switch while in the closed position.

The instrument and control board for the Gatun generating station is of natural black slate, as are all the switchboards for the power system. It is totally enclosed by means of grille work with doors at each end. The switchboards for the transmission line substations are of the vertical type, with control apparatus and mimic connections symmetrically arranged on the middle section of the panels. The rear of the board is enclosed by means of grille work with doors at each end.

Power Supply and Control Panels for Lock Machinery Motors

Current for the lock machinery and towing locomotives is transformed from the 2200 volt system in the immediate vicinity of where it is used. There is a total of thirty-six transformer stations, for all locks, each containing duplicate 200 kva. 3-phase 2200-240 volt transformers for power and one single-phase 25 kva. 2200-220-110 volt transformer for lighting. The stations, normally fed from the 2200 volt buses in the 44,000-2200 volt substations, can also be operated from the power plants; the stations at Gatun locks from the Gatun hydro-electric station; and the stations at Miraflores and Pedro Miguel from the Miraflores emergency steam plant.

To give an idea of the number and sizes of motors to be controlled in operating the lock machinery, the following table is interesting:

Machines and operation.	Motors each machine and hp.	Number of motors. Gatun.	Pedro. Miguel.	Miraflores.	Total.	Total horsepower.
Miter gate, moving, each leaf.....	1—25	40	24	28	92	2,300
Miter gate, miter forcing.....	1— 7	20	12	14	46	322
Fender chain, main pump.....	1—70	16	16	16	48	3,360
Fender chain, operating valve.....	1—½	16	16	16	48	24
Rising stem gate valve.....	1—40	56	24	36	116	4,640
Cylindrical valve	1— 7	60	20	40	120	840
Guard valve	1—25	6	6	6	18	450
Auxiliary culvert valve.....	1— 7	4	4	4	12	84
Totals		218	122	160	500	12,020

There are many motors not included, as, for instance, those for the spillway gates, for the hand rails on the mitering gates and for the sump pumps. The spillway gates are remote-controlled from a special control board, and the control of the hand-rail motors is given in connection with the discussion of mitering gates.

The motors are started and controlled by contactor panels situated near them, the contactors of which handle the main motor currents. These contactors are controlled from the central control house. The smaller motors, including those for cylindrical valves, auxiliary culvert valves, and miter forcing, are started by being thrown directly on the line. Two double-pole contactors are used, one for forward and one for reverse. In the case of larger motors

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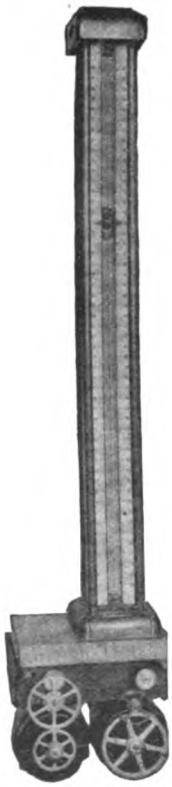
for miter gate moving, rising stem valves, and guard valves, a starting point with resistance in two legs of the three-phase circuit is provided.

In all cases the contactors are operated from the control boards—to be described later—by three wires, one for forward, one for reverse, and a common return. In the case of panels having a starting point, the period during which the motor remains on



WATER-LEVEL INDICATOR.

the resistance is automatically controlled by a dashpot, so that the starting operation at the control house is the same, simply energizing a forward or reverse wire, as the case may be. The control connections are arranged in such manner that each individual machine may be controlled locally. This arrangement provides for emergency operation should the control circuits from the central control house be out of order.

Location and Operation of Lock Machinery

From an operating standpoint the machinery was placed below the coping of the lock walls, thus affording a clear space for maneuvering ships and protecting the apparatus from the weather without erecting numerous houses.

The mitering gates consist of two massive leaves pivoted on the lock walls which operate independently of each other. A pair of gates is placed where each change of level occurs and divides the locks into 1000-ft. chambers. In addition to these gates, at lake and ocean ends are duplicate pairs of gates used as guard gates. To handle the vessels of various sizes with the minimum use of water, mitering gates of the same description as those above are installed, dividing 1000-ft. locks into two compartments. These gates are termed intermediate mitering gates. When the mitering gates are closed, they are what might be termed clamped in this position by a device called a miter forcing machine.

On the top of all mitering gates a foot-walk with hand-rails is provided. When the gates are opened and in the recesses provided for them in the lock walls, these hand-rails would interfere with the passing of the towing locomotives, except in the case of the lower guard gates. The hand-rails are therefore made to be raised and lowered. This is done by a motor under the foot-walk, controlled from the lock wall. Near the approach to each foot-walk a controller is placed in the lock wall flush with the surface, this controller being operated by a foot-push. If the gates are closed and the hand-rails are down, and it is desired to cross on the gates, the foot-push is pressed and the hand-rails are raised by their motors. This is true not only of the hand rails on the nearer gate leaf, but on the hand-rails on the farther leaf as well. After passing across, one can, if one desires, press the foot-push on the other side and both hand-rails will be lowered. Or, if one leaves the hand-rails up and the gates are opened by the operator in the control house, they will be automatically lowered so as to be out of the way when the gate is in the recess. When the gates are again closed, the hand-rails will automatically rise again if the foot controller has been operated in the mean time. The hand-rails cannot be raised when the gates are opened, and no harm results if the foot switch is operated while the gates are in the closed position.

The chain fenders are stretched across the canal in front of all mitering gates which can be exposed to the upper lock level and

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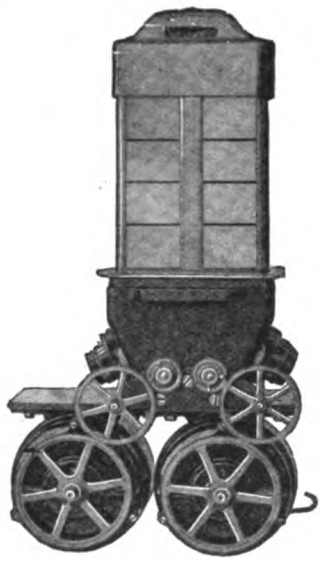
also in front of the guard gates at the lower end. These chains are maintained in a taut position when the gates behind are closed, and are lowered when the gates are opened for the passage of a ship. The chains are raised and lowered by a method similar to that followed in hydraulic elevators, with the additional feature that if a ship approaches the gates at a dangerous speed and rams into the chain, the chain is paid out in such a way as to gradually stop the ship before it reaches the gates. Lowering the chain for the passage of a vessel and raising it again after the vessel has passed



RISING STEM VALVE INDICATOR.

is accomplished by two motors; one driving the main pump supplying water under pressure, and the other operating a valve which controls the direction of movement of the chain. These two operations are combined in one, each motor being stopped automatically by a limit switch when the motor has performed its function.

The filling and emptying of the locks is accomplished by three culverts, one in the middle wall and one in each side wall, the flow of water being controlled by rising stem valves. They are placed in the culverts at points opposite each end of each lock so that the culvert can be shut off at any desired point for filling a lock with water from above, or upstream, or for emptying it by allowing it to flow out and down to the next lock. Lateral culverts conduct the water from the main culverts, under the lock chambers and up through openings in the lock floors.

The rising stem valves are installed in pairs, and each pair is in duplicate; also each culvert is divided into two parallel halves at these valves by a vertical wall. This arrangement reduces the size of each valve and makes it more easily operated, each valve being 8 by 18 feet. One pair of duplicates is left open as a guard, or reserve pair; the other pair is used for operating, so that in case of an obstruction in the culvert or accident to the machinery, the duplicate pair can be used.

At the upper ends of the culverts at the side walls, the duplication is accomplished by three valves in parallel, called the guard valves. They perform service exactly similar to the rising stem valves, except that three valves in parallel in this case must conform to the same laws as the two in parallel in the other case.

The culvert in the middle wall must serve the locks on both sides, and to control this feature, cylindrical valves are placed in the lateral culverts that branch out on each side. There are ten of these on each side of the culvert at each lock.

At the upper end of each set of locks there are two valves in the side wall for regulating the height of water between the upper gate and upper guard gate, as it is desired to maintain the level of the water between these gates at an elevation intermediate between that of the lake above and that of the upper lock when the upper lock is not at the same level as the lake. These valves are called the auxiliary culvert valves.

Reasons for Using the Control System Adopted

As the flight of locks at Gatun, for instance, extends over approximately 6200 ft., and the principal operating machines are distributed over a distance of about 4000 ft., it can be readily seen that central mechanical transmission of control of machines would be almost impossible; and to control the machines locally would mean a large operating force distributed practically along the full length of the locks, which has invaribly been the practice heretofore. Such a force would be difficult to coördinate into an efficient operating system. The situation therefore resolved itself into centralized electrical control, which reduces the number

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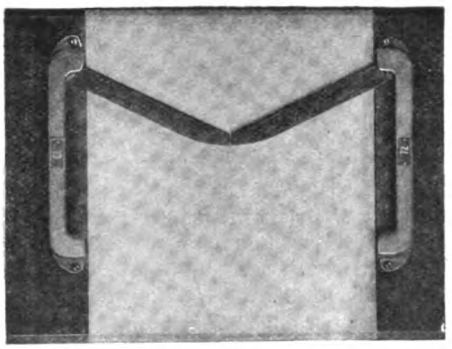
of operators, operating expenses, and liability to accident. To accomplish this system of control, a control board for each lock was constructed which permitted having all control switches mounted thereon mechanically interlocked so as to minimize, if not entirely prevent, the errors of human manipulations.

Centralized Control and Indicating System

The control boards are installed in control houses on the middle walls at points which afford the best view of the locks, although this view is not depended on to know the position of the gates or other



INDEX FOR MITERING GATES.

apparatus, as all are provided with indicators on the control board. The control boards are made approximately operating miniatures of the locks themselves, and are arranged with indicating devices which will always show the position of valves, lock gates, chains and water-levels in the various lock chambers; and with the exception of such machinery as needs only an 'open' or 'closed' indication, the indications will be synchronous with the movement of the lock machinery.

For such indication, appliances with commutators, multiple contacts or ratchet mechanisms would not be suitable, because of the many contacts and small pieces in their construction; and particularly because devices of this character move step by step and would not indicate all points in the movement of the main machinery, such indications being more or less approximate, according to the number of steps in the indicating devices. The indicators on the Panama control boards were developed especially for this undertaking, and show accurately and synchronously every movement of the machinery to which they are connected, whether in the extremes of travel or at any intermediate point.

A complete synchronous indicator consists of a transmitter situated at and operated by the machine in the lock wall, and a receiver operating an indicator at the switchboard in the control house. Both transmitter and receiver have a stationary and a rotating part. The stators have three-phase windings with leads from three corresponding equidistant points brought out and connected together, but not connected to a source of power, the stator coils being energized by induction from the rotors. The rotors are bipolar and are connected in multiple and energized from a 110-volt, 25-cycle, single-phase source.

The movement of the lock machinery and with it the connected transmitter rotor produces a field in the transmitter stator polarized in the direction of the rotor axis, which induces voltage in the stator coils. This voltage is transmitted by the three-phase connection above mentioned to the receiver stator coils and duplicates in them, but in the reverse direction, the same conditions of polarity and voltage as present in the transmitter. The rotor of the receiver being energized by the external source in the same direction as that of the transmitter, is reacted upon by the polarized receiver stator until the magnetic axes coincide and the rotors of both transmitter and receiver are in the same relative position. Any difference in the position of the transmitter and receiver rotors causes a difference of potential between the stator windings with a consequent flow of current and resultant torque, which again moves the receiver rotor to the same relative position as that of the transmitter rotor. The receiver rotor follows closely and smoothly the movement of the transmitter rotor, and consequently imparts to the position indicator a movement identical with the movement of the lock machine, although on a scale reduced to the requirements of the control board. A brief description of the individual synchronous indicators follows.

In the case of the mitering gates, the vertical operating shaft is connected to a shaft which operates the transmitter machine. The latter shaft is threaded and carries a nut on which is mounted a rack. The rack

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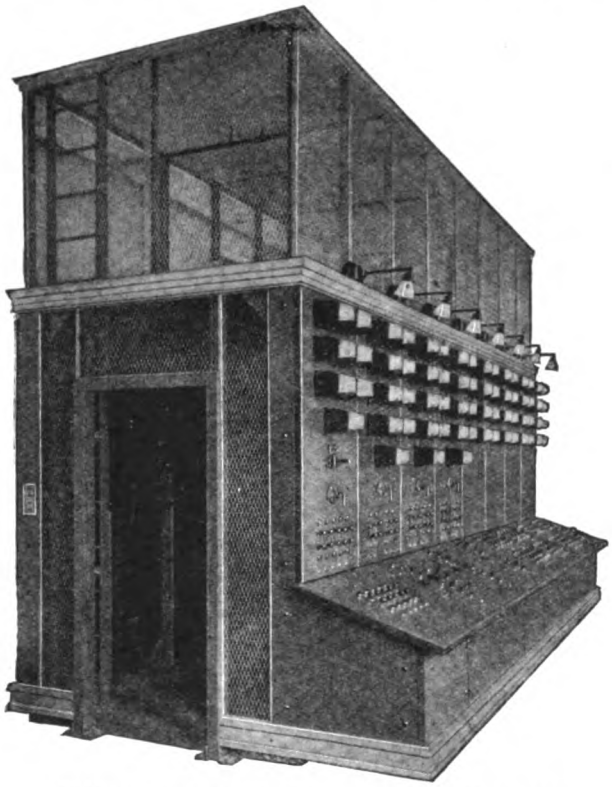
engages a gear on the rotor shaft, and this turns the rotor as the gates operate. The mitering gates indicator comprises a pair of aluminum leaves, shaped to correspond to the plan view of the top of the gate, which travel horizontally just above the top of the board, the hinge ends being connected to shafts extending down through the surface of the board where they are geared to the receivers by means of bevel gears. When the miniature gates are completely opened, they are covered by shields to give the effect of the gates folding back into recesses in the lock walls.

For the chain fender, the position indicator transmitter is driven by the shaft which operates the limit switch that controls the stroke of the piston. The indication on the board is given by a small aluminum chain, which, like the large chain, is raised and lowered, each end operating independently, the large chain being lowered to the bottom of the lock and the small chain into a slot on the control board. The ends of the miniature chain are fastened to semaphore arms which are connected to segmental gears meshing with the driving gears on the receiver machines. As the receiver rotors turn, the chain is either lifted or lowered, the position of the large chain from the bottom of the lock being indicated by the angle of the semaphore arms.

As the rising stem valves occur in pairs, their position-indicator machines occur in pairs also. The transmitter rotor is driven by a shaft and gearing similar to that described for the mitering gates. Each indicator is similar to a small elevator, a car being used to indicate the position of the valve gate. Both front and back of the shaft is fitted with opal glass marked with black lines for the ¼, ½, and ¾ positions. A small aluminum cage moves up and down in each compartment. A drum for operating the cord which raises and lowers the cage is placed underneath the control board and is operated by the receiver through a suitable train of gears. To make the indications visible from points up and down the control board, the elevator shaft under each car is



2200-VOLT A. C. INSTRUMENT AND CONTROL BOARD.

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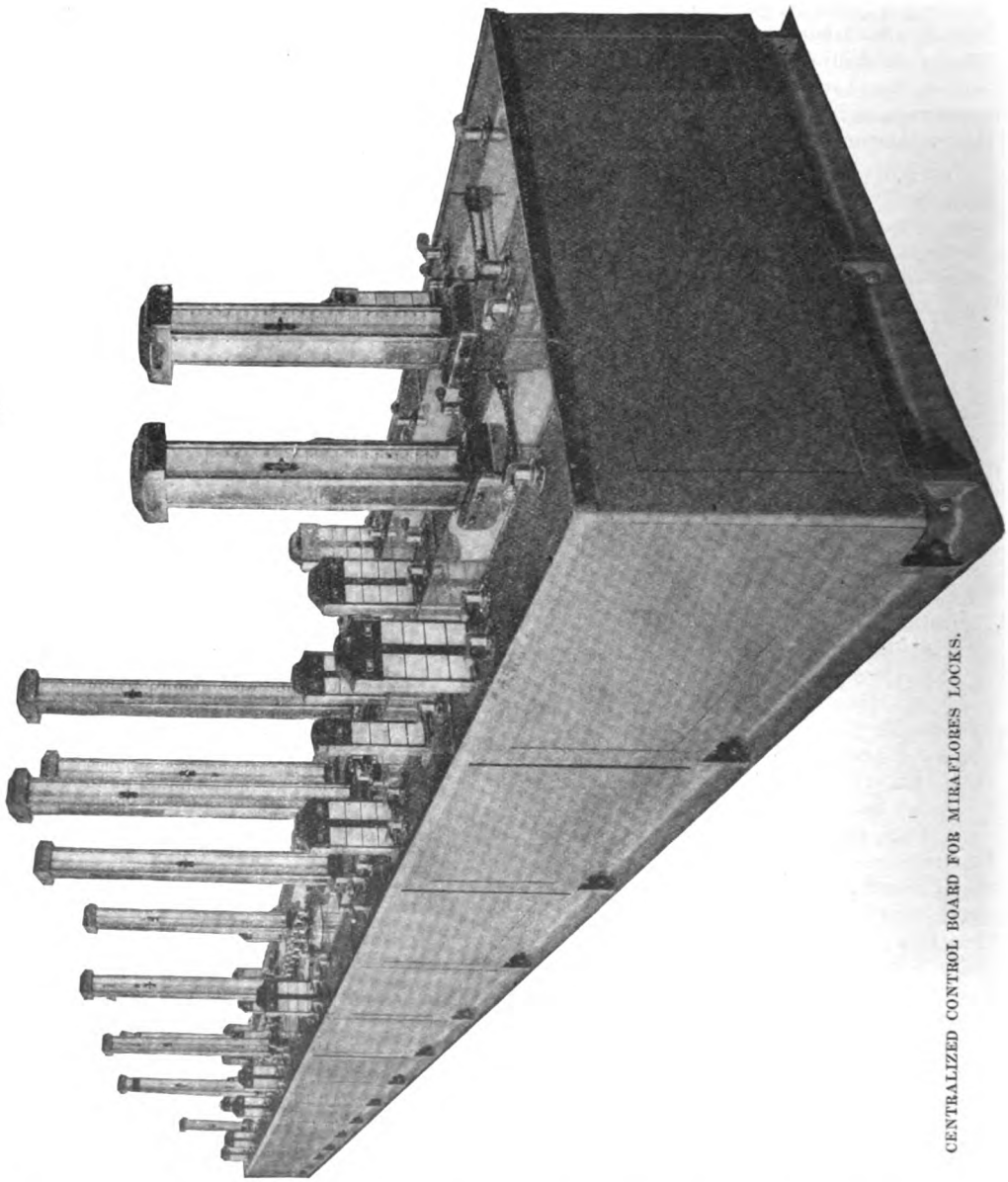
always illuminated and the portion above is dark.

Water-Level Indicators

The specifications covering the water-level indication required an accuracy of 1/20 of a foot or 1/10 of 1 per cent in actual water-level. In the transmitters and receivers for the machines described previously, the rotors turn less than 180° with an inherent lag of 1½% between transmitter and receiver rotors in this distance, which obviously prevents this arrangement from being employed to give the water-level indication.



CENTRALIZED CONTROL BOARD FOR MIRAFLORES LOCKS.

It was found that if the rotors were revolved ten complete revolutions, the required accuracy could be obtained; but since this arrangement makes it possible for the rotors to be in synchronism every 180°, or in twenty different positions for

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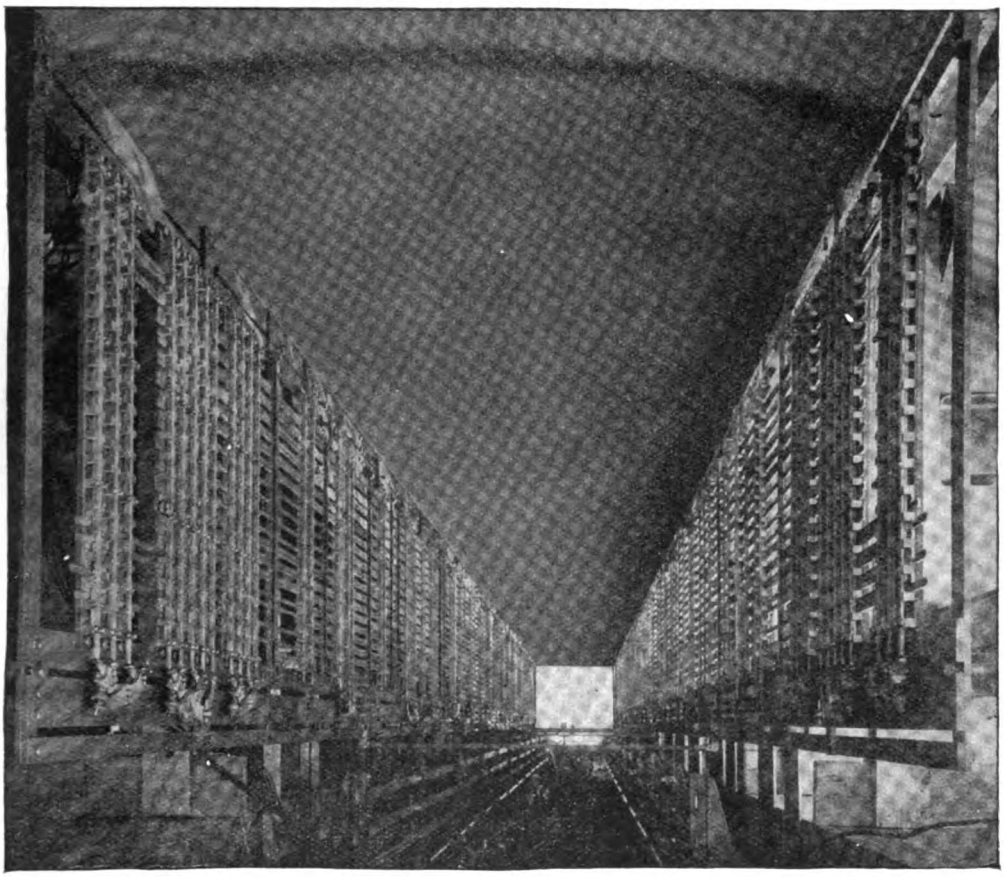
the entire travel, the indicators would not indicate correctly if for some reason the transmitter rotors were turned more than ½ revolution with the power off. Therefore the required accuracy was obtained by two sets of transmitters and receivers, one set connected to a fine index in which the rotors make ten complete revolutions and the other set connected to a coarse index operating less than 180 degrees.

The fine index is a hollow cylinder carrying a pointer, the length of the cylinder being such that when an aluminum ball representing the coarse index, which can be depended upon for coarse indication, is within the limits of the cylinder, the reading of the fine index is correct within the limits specified. The scales are illuminated by lamps in both base and top caps of the indicator.

For water-level indication, wells 36 in. square in the lock walls with communication to the lock by a small opening at the bottom of the well to dampen surges contain a welded steel box float, 30 in. square by 9 in. deep. A non-slipping phosphor bronze belt transmits the movement of the float to a sheave fitted with pins on the transmitter mechanism, the pins registering with holes punched in the belt. The sheave shaft is carried in ball bearings with oil cups for lubrication and drainage cocks at the bottom of the bearings.

The position of the miter forcing machine is not indicated by synchronous indicators, but its open and closed positions are shown by red and green lights and a mechanical indicator on the control board representing the machine, which is sufficient for all practical purposes.



INTERLOCKING SYSTEM BELOW THE MIRAFLORES BOARD.

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Control Boards Represent Locks in Miniature

The control boards are of the flat top benchboard type, 32 in. high by 54 in. wide, built in sections, with total lengths as follows:

	Feet.
Gatun	64
Pedro Miguel	36
Miraflores	52

The side and centre walls of the locks are represented by cast iron plates and the water in the locks by blue Vermont marble slabs. The outer edge of the board is surrounded by a brass trim rail, and the sides are enclosed with steel plates which can be readily removed for inspection of the board. The control board is supported by a wrought iron framework resting on base castings, which are in turn supported on the operating floor of the control house.

The control switch handles are mounted above the surface of the board and operate through an angle of 90°. They are provided with name plates for the 'open,' 'closed,' and 'off' positions. The space immediately below the flat top of the control board is occupied by the contact fingers of the control switches, mounted on the operating shaft, synchronous receivers and their cable connections. Connection boards are provided for the cables, which are led up from each side, as are buses for supplying current to the control switches, receivers, and the lamps that illuminate the scales of indicators. The receivers, transmitters, and lamps are operated at 110 volts, while the control circuits are 220 volts, both using 25 cycle alternating current.

Mechanical Interlocking System

In order to make it necessary for the operator to maneuvre the control switch handles always in a certain order, corresponding to a predetermined sequence of operation of the lock machinery, and to prevent the operator in control of one channel from interfering with the machinery under the jurisdiction of the operator controlling the other channel, these control switches are provided with interlocks. The interlocks are in two vertical racks under each edge of the board and some distance below, so that they may be inspected and oiled from a floor which is about seven feet below the floor on which the switch-board operator stands. The latter floor does not extend across under the board, this space being open so that all parts on the underside of the board are accessible from the floor below.

Vertical shafts operated by connecting rods from the control switch shafts extend downward past the electrical parts for the operation of the interlocks. The interlock system is essentially a bell crank mechanism, connecting the shaft of the control switch through a movable horizontal bar to a vertical operating shaft which can or cannot move, according to the relative positions of the interlocking bars and dogs. The interlocking rack is a steel frame carrying five horizontal members. Upon these and tying them together are vertical steel straps which carry brass runway posts for the vertical and horizontal interlock bars. These posts are riveted to the vertical steel straps, a thin brass plate between posts and straps making the runways non-corrosive. The vertical operating shafts are of square steel turned on the ends and work in brass bearings near top and bottom of the interlocking rack. Forked cranks mounted on the vertical operating shafts move the horizontal interlock bars by means of pivot blocks set over pin blocks riveted to the horizontal bar. The interlock bars and dogs are of special shape hard extruded brass, which section keeps the dogs in line with the axis of the bars when under pressure by being engaged with another dog on a vertical bar. Every control switch uses a horizontal bar of from 3 to 50 ft. long.

The interlock system depends mainly on the action of engaging bevel dogs situated on horizontal and vertical bars, the movement of a horizontal bar tending to lift a vertical bar by bevels on the dogs. A horizontal bar cannot be moved without raising a vertical bar. Thus if at any time a dog on a horizontal bar rests against the upper end of a dog on a vertical bar, no movement of the horizontal bar where the dog engages with the vertical bar can take place, and the control handle connected to that particular horizontal bar is locked.

Interlocks prevent the chain fender from being lowered until adjacent mitering gates have been opened, and also prevent the gates being opened until the chain is in the raised position. In this way it is assured that the chain fender will always be in the up position to protect the gate when the gate is closed. To avoid unnecessary complication,

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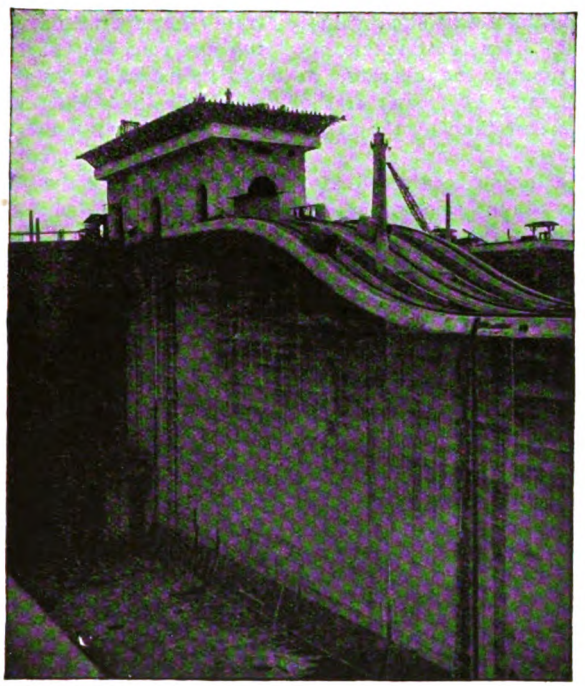
each end of the chain is interlocked with the leaf on its side of the lock only, because as a rule both leaves of a gate, as well as both ends of a fender chain, will be opened simultaneously, and further interlocking is unnecessary. After the mitering gates are closed, a miter forcing machine is operated by a control handle and locks the ends of the gates closed. This machine cannot be operated until the gates are closed.

Also the rising stem valves of the side wall, next above or below a miter gate, must be closed while the miter forcing machine is open. As the miter forcing machine cannot be closed until the gates are closed, this means that the valves either above or below the gate must remain closed until the gate itself is closed, thus preventing the operator from creating a current of water around the gates while they are open, or being moved in opening or closing. This interlock is not included on the middle wall valves for the reason that they will be used with the locks on either side and must be free for that purpose.

Either pair of rising stem valves may be opened first, at the choice of the operator, an interlock becoming effective when the first valve of the second pair of duplicates is opened. This is done by a novel arrangement of equalizing levers acting against the ends of the interlock bars, with certain definite amount of lost motion which is taken up on opening the first pair of valves, thus putting the interlocks in operation on the next pair. To illustrate this operation, consider, for example, a side wall culvert at Gatun with its principal rising stem valves at each change of level from one lock to the next. The control of these valves is interlocked so that if the valves are opened at one particular point, the valves a lock length upstream or downstream cannot be opened. Thus the operator is limited to equalizing the water between locks and cannot allow water to flow from the upper lock past the middle lock into the lower lock, which operation, if permitted, might flood the lower lock walls and the machinery chambers in them. The cylindrical valves are interlocked so that if those on one side are opened the ones on the other side are locked closed, and the opening of one switch on a side will lock the opposite ten. This prevents careless



CONTROL HOUSE AT GATUN, WHERE LOCK CONTROL BOARD WILL BE INSTALLED.

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cross filling between locks, which operation might be combined with the regular method and produce flooding. However, there may be times when it is desirable to employ cross filling to economize in the use of water from Lake Gatun in the dry season. For this reason this interlock is made removable by the use of a Yale lock and key. The key will be placed in the hands of the chief operator.

In the use of the middle wall culvert, the cylindrical valves on one side or the other must be opened before the rising stem valves can be opened, and the rising stem valves must be closed first. This interlock is applied in order to require the operator to control the flow of water by means of the rising stem valves rather than by the cylindrical valves.

In most cases the locks are divided into two unequal parts by the intermediate mitering gates. This arrangement makes it necessary to divide the ten cylindrical valves into two groups of seven and three, respectively, for the long and short lengths. A selecting lever is provided for these interlocks and may be set as indicated by a name plate on the lever to 'three,' 'seven,' or 'ten,' respectively; whereupon the corresponding valves are subject to that interlock, and the others of the group of ten are locked closed if three or seven only are to be used. The failure of the operator to make his selection properly in advance will simply cause him the trouble of going back and doing so, as the remaining valves are locked closed. This arrangement permits handling small vessels without causing waste of water due to operating such vessels in the large chambers. If a short vessel were being passed downstream, it would first pass into the chamber having three cylindrical valves. The group selective lever would then be placed on the 'three' position, which would permit the opening of three valves above the inter-intermediate gate, but would lock closed the other seven valves above it. After the vessel had been passed below the gate the handle may be reversed releasing the lever and locking three switches.

There are intermediate rising stem valves in the side walls at each intermediate gate, but no interlocks are applied to these, for the reason that they will be used in a more or less irregular manner, and no fixed laws for their operation can be made in advance. Moreover, they control the water only between different sections of the same lock, and there is not the danger from mistakes in operation which exists in the case of the other valves which control water between lock levels. The same is true of the small auxiliary culvert valves, by means of which the space between the upper guard gate and upper main gate is filled and emptied.

In case a large vessel is to be locked through, the interlocks on the intermediate gates can be made ineffective by the operation of a Yale lock which uncouples a clutch and disconnects the central switch from the operating mechanism. Turning the key removes the interlock and permits the intermediate gates to be thrown open to obtain a 1000-ft. level and the valves operated independently of these gates.

To obviate the possibility of flooding the locks when the valves are in a certain position, diagonal interlocking is introduced between the rising stem valves of the side wall and those of the middle wall a lock length away. This interlocking between valves diagonally across a lock when the cylindrical valves are open is needed to prevent the flow of water from, say, the upper lock by way of a side wall culvert to the middle lock, thence by way of the middle wall culvert to the lower lock, thus allowing an operator through carelessness to flood the lower lock walls. If the cylindrical valves of a certain lock are closed, the interlock is not needed on the rising stem valves of that lock; and since such interlock would interfere with the proper use of the valves of its twin lock on the other side of the middle wall, this interlock is automatically removed when all ten cylindrical valves are closed on the particular lock in question, and is automatically applied again if one or more of the ten cylindrical valves are opened. Furthermore the valves of the side wall immediately at the gate which is being moved will be open to equalize water-level, and diagonal interlocking will prevent the opening of the middle wall valves a lock length above or below the gate being moved. Each of the four valves of such a group has independent control, their control switches being so interlocked that either pair may be opened and left open as guard valves, the interlock becoming effective when the operator tries to open the first valve of the second pair. In addition to these pairs of valves in parallel, each pair is duplicated

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at each change of level from one lock to the next.

Special Climatic Requirements

To withstand the humid atmosphere of the isthmus, every insulated part, such as solenoid, relay, circuit breaker, and other coils, was impregnated with non-hygroscopic compounds. All small parts were made either of brass, copper, Monel metal, bronze, or of sherardized iron or steel. Mica and treated asbestos lumber were used largely in place of fibre or wood.

Manufacturing Details

Nearly two thousand special drawings were required in the fabrication, and there were also involved the following unusual quantities of materials.

Special slate bases	1,300
Small castings	160,000
Screw machine parts	1,200,000
Copper rod and bar, ft.	58,000
Asbestos lumber, sq. ft.	9,000
New patterns	650
New jigs, templates, tools, etc.	625
Porcelain parts	18,000
Special bus supports	6,800
Galv. pipe (framework) ft.	21,000
Special gears	2,300
Special instruments	640
Miscellaneous sherardized pieces	300,000
Cases for boxing	4,150

The combined weight of the centralized control boards for Gatun, Pedro Miguel, and Miraflores is about 39 tons. In their construction there is employed more than 2¼ miles of interlocking rod; about 6,000,000 ft. of control leads, made up in 5 and 8-conductor cables; 732 indicator motors; and 464 control switches.

All of the lock machinery motors, control panels, centralized control boards, power-station generating apparatus, switchboards, transmission-line sub-station equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine-shops were manufactured by the General Electric Company.

New National Safety Organization*

By R. W. CAMPBELL

THE manufacturers of this country are today confronted with a very vital problem, that is, what shall be done in the way of accident prevention work? There is not an industrial concern actively engaged in business today which does not recognize this fact. Increased efficiency and economy of operation practically make it a necessity. Humanity demands it. The spirit of the times calls loudly for it and 'Safety First' has become one of the slogans of the day.

There is likewise an ever-growing need for accident prevention work. The daily toll of loss of life and limb in accident and disaster throughout the country is a sufficiently potent argument, if any be necessary, to substantiate such a statement. Nor is the value of safety work any longer seriously questioned. The experience of recent years has shown that where such work is earnestly and seriously undertaken a reduction of 33 1/3 to 70% can be made in the number of accidents in industrial plants where even the greatest hazards exist. It is, therefore, a practical work.

Every thinking person recognizes that any loss of energy is waste. The loss of time by an injured workman is waste both to his employer and to himself. From nearly all accidents there also results a disorganization of the working force, which varies with the seriousness of the accident. In some trades all work ceases for the day upon the happening of a serious accident. All of this disorganization is likewise loss and waste. The accident in nearly every case calls for compensation to the injured employee or his dependents, if he be killed, and likewise usually entails a cost in repair to damaged product or machinery, all of which is waste and loss. Safety work, therefore, results in economy, an important consideration among all employers.

An employee, even of the unskilled class,

*Abstract from *Manufacturers News*, Oct. 9, 1913.

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careful for his own and others' safety, is more careful of his employer's property and does his work better than his careless fellow workman. An injury to a workman calls for the substitution in his place of a green man, who cannot be as efficient as his experienced predecessor. Likewise an earnest movement for safety in any industrial plant tends to affiliate more closely the employee with his employer and results in a more loyal allegiance and more earnest coöperation on the part of the employee toward his employer. Love begets love and interest creates interest. Safety work, therefore, results in increased efficiency. Above all, however, accident prevention is humanitarian work to which today the finger of duty points. It is an obligation which honestly may not and should not be avoided or delayed in its fulfillment.

A study of preventable accidents and of the safety work of federal and state bureaus, such as Federal Bureau of Labor and those of the states of Wisconsin, Minnesota, New York, and Pennsylvania, of the large transportation and industrial concerns of the country, such as Chicago & Northwestern Railway Company, Chicago Railways Company, Brooklyn Rapid Transit Company, International Harvester Company, General Electric Company, Remington Typewriter Company, American Steel Foundries, and the United States Steel Corporation and its several subsidiary companies, of public and semi-public activities, such as the Public Safety Commission of Chicago and Cook county, American Museum of Safety, chambers of commerce and national and state manufacturers and trades associations, and of hundreds of other concerns and activities too numerous to mention, will show that where any successful safety campaign is waged, it is necessary to provide and maintain proper working conditions and proper and efficient safeguards upon dangerous machines and appliances, and to educate and inculcate habits of caution. This experience has also shown, and it will be conceded by all, that a comprehensive organization to formulate and carry out a definite plan or program for such a campaign is absolutely essential. There must also go hand in hand with organization the hearty coöperation of all those involved in the common undertaking and the widest publicity possible.

The experience of the past years has also demonstrated that conferences and interchange of ideas and experience has been of great benefit and that the results of the labors of those who have been engaged in accident prevention work have been of great value to those commencing such work, who very often hesitate to request information, data, etc., from others which otherwise would be readily available. It has, therefore, seemed to many of those engaged in accident prevention work that it was a waste of energy and loss of time for each industrial concern to have to go over the same experimental ground which others have covered and that there ought to be some medium or agency whereby any one interested could have access to the knowledge and experience of others, thus bringing about the highest measure of coöperation, which agency also might promote gatherings where common problems could be discussed.

Having these requirements and needs in mind, a year ago at the first coöperative safety congress held at Milwaukee, Wis., under the auspices of the Association of Iron and Steel Electrical Engineers, there was appointed by that Association and its guests at the congress, a committee to take charge of the formation of a National Safety Organization and to promote a second safety congress to be held jointly with that Association a year later.

The National Council for Industrial Safety was organized during the year as the result of the efforts of that committee and was formally launched at the second safety congress held under its auspices in New York City, September 23 to 25, 1913.

The object of the National Council for Industrial Safety as expressed in its constitution and by-laws is to promote the conservation of human life and its incidents in the industries of the nation and to that end:

Objects of Council

(a) To establish a conveniently situated headquarters for the maintenance of a clearing house of safety information available to all concerned.

(b) To encourage and promote throughout the country the organization of those engaged or interested in safety work into District and Local Councils, in affiliation with this National Council.

(c) To hold annual congresses, at which all persons interested in accident prevention and kindred subjects may take part in prac-

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tical discussion of vital problems, and also having opportunity to examine carefully prepared exhibits; to publish and give wide distribution to proceedings of such congresses; to give awards for meritorious exhibits, safety devices and other accomplishments in line with the objects of the Council.

(d) To encourage and assist in the practical standardization of safety devices, safe conditions and practices.

(e) To give the widest publicity, through its own publications and other channels, to all matters calculated to promote industrial safety.

(f) In general to initiate, promote, coöperate with and obtain the assistance of, any and all activities of agencies calculated to conserve human life and its incidents in the Nation's industries; and to participate in and aid other activities for the welfare of the industrial workers of the country.

Any person, firm, corporation or organization interested in forwarding the objects of the council may be a member.

There are three classes of members in the council, namely, honorary members, associate members, and active members. The members of an association consisting of persons who otherwise might be eligible to membership in the council, are eligible only to associate membership in the council. All other members, except such as may have been elected to honorary membership by the executive committee, are active members.

For the purpose of stimulating activity in accident prevention and promoting discussion and consideration of problems in connection therewith, one of the principal functions of the council is the promotion of the organization from among its members in geographical districts of local councils, and to this end the by-laws provide that whenever any five active members of the council in any geographical district shall so desire, they may organize themselves into a local council of the council.

Active membership in the council is a requisite to membership in a local council. Membership in a local council does not relieve a member from responsibility to the council for dues provided for in its by-laws. The council, however, will pay or cause to be paid to any local council the amount of its expenses up to but not exceeding 20% of the amount of dues paid to the council by the members of such local council.

Annual reports by each local council to the council are required, otherwise local councils may adopt their own constitution and by-laws and carry on their own affairs as they deem advisable; provided, however, the same shall in no wise be inconsistent with the constitution of the council or its by-laws.

To create greater interest in the affairs of the council, its activities will be divided into two sections in accordance with the differences that may exist in the hazards incident to the several industries, such as transportation, textile, boot and shoe, foundry, electric light and power, iron and steel, etc., federal and state bureaus, manufacturers and trade associations and public safety.

From among the members of the council men connected with each of the several sections into which its activities may be divided will be selected to act as chairmen of committees to assist in the accumulating of information and data, to assist in interesting those in their particular industries in accident prevention work, and, as far as possible, to standardize safety devices, practices and rules applicable to the special hazards in their several industries, as well as to provide at each congress of the council a program for their several sections at meetings of such sections, where problems peculiar to the work of their industries and activities can be discussed.

Another principal function of the council will be its work of disseminating information respecting accident prevention work. All of the accumulated data as to safety devices, safeguards, safety rules and regulations, and the experience in methods or plans or organization and education and publicity of all the large industries and federal, state, and municipal bureaus and commissions and other activities will be made available to all who may be interested through the bureau of the council at its headquarters in Chicago.

A secretary who will devote his whole time to the service of the council has been secured, who is widely experienced in organization and safety work. Within a few months' time it is believed by the officers of the council that valuable information will be collected and if not collected such information can be at once obtained for the benefit of those who may desire it. It is also planned through its headquarters to distribute freely information respecting all mat-

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ters of interest pertaining to safety work generally, and to aid and co-operate with all those who may desire to promote safety work.

Lists of speakers, lecturers, organizers, and experts will be compiled and the council expects to be able to meet every requirement of every inquirer for information respecting accident prevention work, no matter what its character may be.

The council hopes to coöperate with and obtain the coöperation of every individual, every industrial or transportation concern, every federal, state, municipal, or other bureau, commission, association, or activity, and through its offices to obtain for each the coöperation of the other. It proposes to undertake itself and assist others in every plan or scheme or enterprise that may have for its object accident prevention, and its sole hope is that it may receive the hearty coöperation and support of all those whose aim and purpose is the conservation of human life and limb in and about the industries and public activities of the country.

The council is now thoroughly established and will be a most important factor in the accident prevention work of the country. Its headquarters are in the Continental & Commercial National Bank building, Chicago, Illinois, and are in charge of its secretary, William H. Cameron, formerly safety engineer of American Steel Foundries, and of the writer, its president.

Petroleum Production in 1913

THE following is an estimate of the production in 1913, compared with the statistics for 1912:

PETROLEUM PRODUCTION IN 1913 (ESTIMATED) AND 1912, IN BARRELS.

State.	1913.	1912.
California	98,000,000	86,450,767
Oklahoma	62,500,000	51,427,071
Illinois	22,000,000	28,601,308
Texas	14,000,000	11,735,057
Louisiana	12,000,000	9,263,439
West Virginia	11,000,000	12,128,962
Ohio	8,000,000	8,969,007
Pennsylvania	7,000,000	7,837,948
Wyoming	3,000,000	1,572,306
Kansas	2,000,000	1,592,796
Indiana	900,000	970,009
New York	800,000	874,128
Kentucky	500,000	484,368
Colorado	200,000	206,052
Other states	100,000	.....
Total	242,000,000	222,113,218

The remarkably great output of petroleum during each year of this century was more than maintained in 1913. The amount produced in the past 12 months exceeded 240,000,000 barrels, or about 32,000,000 metric tons, according to estimates of David T. Day, of the U. S. Geological Survey. The production in 1912, which made the record up to that time, was 222,113,218 barrels. The rate of increase in 1913 was greater at the end of the year than at the beginning. California increased at least 10,000,000 barrels over 1912, almost reaching 100,000,000 barrels. The consumption in California almost equaled the production, and the addition to stocks was very slight. Oklahoma also showed a significant increase, with about 6% addition to the stocks. Texas and Louisiana likewise increased their product. The output of the Gulf field declined, but this was more than offset by the increases in northern Louisiana and Texas. Wyoming showed a significant increase from the Salt Creek field. Other states generally showed a decline, which was greatest in Illinois.

Appalachian Region.—In New York and Pennsylvania great efforts were made to increase production by new drilling and more especially by cleaning out old wells. No great success was obtained, and the usual decline resulted. A deep test boring at Derrick City, near Bradford, Pa., was carried to 5673 ft. with the hope of finding oil in the Medina sands. This boring is being continued.

In West Virginia no new pools comparable with the Blue Creek discovery of the previous year were opened. The drilling in Roane, Ritchie, and many other counties was successful enough to check the expected decline due to the decreased yield of Blue Creek. The possibilities of finding oil in western Kentucky aroused general interest.

Eastern Ohio was actively drilled with fair results, and in the Ohio River region an interesting innovation in handling old wells

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gave promise of very beneficial conservation of old oilfields in the future. Compressed air was forced into the nearly exhausted oil-bearing sands through a well situated centrally in a group of old wells and the increase in yield was marked.

Limestone Fields.—The decline in the Lima (Ohio and Indiana) field was no greater than usual; in fact, the new development in Sullivan county, Ind., added an encouraging new supply. Illinois continued the marked decline of 1912. Wildcatting gave unsatisfactory results.

Mid-Continent Field.—The entire Mid-Continent region showed an increase, with a total record output. In Kansas prospecting returned to many localities which had been temporarily abandoned when the Glenn pool attracted all the available capital to Oklahoma. During the last year the high prices asked for favorable locations in Oklahoma reacted in favor of Kansas. The phenomenal bonuses obtained in auctioning leases on Osage Indian lands showed the high value of Oklahoma lands. The oil also increased in price to $1.03 a barrel and would have gone higher but for the excessive production, which put oil into storage and created uncertainty as to future prices. Besides satisfactory development of the new Cushing and Cleveland pools, interesting prospects for new pools have been found at Newkirk, Wann, and Healdton.

Large Wells in Louisiana.—As usual, many large wells, difficult of control, were obtained in the Caddo region, Louisiana, including Mooringsport, and fires were disastrous. The product was irregular but showed an increase. In the Gulf region the product declined.

Through the efforts of the Louisiana Conservation Commission, the U. S. Bureau of Mines, and the oil operators, the gas well near Oil City, which had run wild since the opening of the Caddo region, was closed.

Increase in Texas.—The Electra and other fields in northern Texas continued to increase, and the decline in the Gulf region was slight. Much wildcatting was in progress at many points over the state. Chief interest centred in a new development at Moran, in Shackelford county.

Increase in Wyoming.—Production increased in the Salt Creek field of Wyoming, and the erection of additional refineries was commenced. An important suit was begun by the federal government to recover oil lands entered upon since the first withdrawal order of ex-President Taft.

Increase in California.—At the close of 1912 consumption in California had so nearly balanced the productive rate as to encourage the producers and at least to defeat concerted effort toward restriction of drilling. Many of the wells of 1913 were gushers of the phenomenal type and aided greatly in increasing the supply. The efforts to increase consumption succeeded fairly well, so that except during the month of greatest production, September, when about 9,000,000 barrels were produced, the consumption almost kept pace with the output and the amount sent to storage was less than a million barrels.

The Fullerton field continued to yield large gushers with sufficient frequency to justify the attempts to reach the unusually great depth of the oil sands.

Farther north the west side fields of Kern county continued as strong factors in the increasing output of the state, and the Buena Vista Hills, Elk Hills, and other new districts gained in interest. Even the comparatively old Kern River field near Bakersfield sustained interest by wildcatting to the northwest, where the Standard Oil Co.'s well went into oil and aroused geologic and financial speculation over a large area. The product of the district declined.

Coalinga's year had many eventful features, including extensions of territory to the east and the discovery of additional deep sands yielding oils containing paraffin. The value of the field was indicated by the sale of the California Oil Fields, Ltd., to the Shell Trading & Transportation Co., an ally of the Royal Dutch Syndicate, late in the year.

The Santa Maria field benefited by increased technologic development by which the oils were topped and dehydrated with markedly greater efficiency. These developments included the successful introduction of the Cottrell electric dehydration process. The adoption of the Trumble and Dyer topping and dehydrating processes and the great advance in methods for obtaining gasoline from natural gas were among the striking achievements of the year, but while less spectacular, the economies effected by many minor improvements in the great refineries at Point Richmond, Oleum, and El Segundo contributed perhaps equally to the general problem of efficient refining.

In transportation the new pipe-line of the

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General Petroleum Co. over Tehachapi pass effected cheaper transportation to the south, and the natural-gas line to Los Angeles was equally advantageous. Meanwhile several new tank oil carriers and oil-burning steamships were added to the Pacific Coast trade and aided in increasing consumption.

Fuel Oil for the Navy.—On account of the increased cost of fuel oil for battleships and the fact that foreign corporations are rapidly purchasing reserves of oil in the United States, the Secretary of the Navy has recommended to Congress the policy of producing crude oil from the naval reserves and obtaining fuel oil from it.

There has been unusual progress in many parts of the country during the year in petroleum refining, especially in the dehydration of heavy crude oils, in obtaining gasoline from natural gas and synthetically from heavy oils, and in obtaining many special products from crude oils.

Oil Production in Foreign Countries.—The feature of chief interest in connection with the foreign petroleum industry in 1913 was the active prospecting for new oil deposits. This prospecting extended to very remote regions including South Africa, southern Chile, Patagonia, many islands of the Pacific, China, Japan, and the East Indies.

The prospecting of most interest to the United States was that in the West Indies, Central America, and South America, on account of the approaching completion of the Panama canal. In Venezuela, American capitalists were actively prospecting in many regions, chiefly along the northern border. More than 20 field parties were engaged in exploration with a view to the selection of the most promising oilfields that might be developed, working under a provisional concession from the Venezuelan government. These capitalists and others were also actively and successfully developing oil concessions on the adjacent island of Trinidad.

In Colombia, English, American, and Canadian oil interests were concerned with concessions for the development of large areas where, though no large oil wells have been developed, the seepages of oil and asphalt are so significant as to lead to the hope of a large addition to the supply of fuel oil. The Cowdray interests withdrew from Colombia in the latter part of the year.

There was delay in developing the oilfields of Argentina, owing apparently to the desire of the Government to retain the oil as a national monopoly.

In Chile a governmental commission examined the oil and gas indications in the Magellan region and made a favorable report.

In Ecuador the Cowdray and other interests carried on a vigorous campaign for the acquirement and development of areas showing oil indications in the interior, as well as in the region of the old wells near the coast.

Interest was shown in the possibility of finding oil in Panama, Costa Rica, Nicaragua, and Honduras, but so recently that there has not yet been time for a significant result.

In the islands of the West Indies prospecting for petroleum was active in Haiti, where a small oil well was drilled near Azua. In Cuba drilling for oil was resumed near Havana, Cardenas, and Motembo. Explorations for oil were also active in Barbados.

In Mexico development work was remarkably active, considering the unsettled condition of the country. It resulted in the development of several large wells in the neighborhood of the great gusher at Potrero del Llano. Another large gusher was obtained at Los Naranjos, on the shore of Tamiahua lagoon, which indicated a considerable addition to the total oil supply. The importance of these additions cannot well be overestimated, for in spite of the universal judgment that the Mexican fields are potentially very great the fact remains that so far as present supply is concerned, Mexico has been practically limited to two, or at best three, large wells and not a very large number of smaller wells of most uncertain character. Of the large wells, the American (Doheny) interests owned two, and the English (Pearson) one. Even with the phenomenal energy of the exploration work it was questionable whether enough, under the peculiar Mexican conditions, to maintain present shipments, let alone supply a combined fleet of about 40 large tank steamers. The supply is now ample. As an evidence of the peculiar character of petroleum commerce, it is probable that with this additional supply the price per barrel will increase, because the greater confidence in the supply will stimulate the adoption of Mexican oil for refining and for fuel.

The 8-in. pipe-line of the Mexican Eagle

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Oil Co. (Pearson interests) was completed from Potrero del Llano to Tampico. The refinery of this Company between La Barra and Tampico, north of Panuco river, is nearing completion. Among many other interesting developments in Mexico was the continued interest in the Topila oilfield, near Tampico, where, in spite of many wells going to salt water, the unusually large gushers occasionally obtained have stimulated continual drilling operations.

A feature of importance for the United States was the development of a large fleet of tank steamers for coastwise and trans-Atlantic trade. Imports of Mexican oil were extended to several refining centres of the United States.

The general interest in the development of new oilfields which characterized the year 1913 extended to Alberta and Saskatchewan, in Canada. Although explorations in Saskatchewan gave either natural gas or else entirely negative results, a well 27 miles southwest of Calgary, in Alberta, struck oil of very light gravity, causing much excitement, and a large territory in that region was taken up by prospectors for oil, probably much more than will be drilled within the next year. This oil excitement extended to the region north of Edmonton, in Alberta, where on Athabasca river and its tributaries, large bodies of so-called 'tar sands' have been known for many years. These tar sands are in places 60 ft. thick where exposed on the river banks and have been traced for considerable distances from the river. Seepages of oil are reported for as much as 400 miles to the north, and many thousands of acres of land have lately been taken up from the Canadian government for oil development at some time in the future.

Work has continued in the developing of the natural gas, petroleum, and oil-bearing shales in the province of New Brunswick.

In Russia the production of oil declined significantly in the larger fields, but meanwhile the Ural-Caspian field was actively exploited. This field is reached by steamers to the north shore of the Caspian sea. There are no wharf facilities yet, landing being made in small boats through the shoal water. About 30 miles from the shore large oil wells have already been obtained, and pipe-lines are being laid to the shore where barges can be loaded and towed up Volga river without the re-loading necessary for shipments from Baku. Exploration in the Ural-Caspian field north of the present oil wells has been extended over many miles and has shown that the area, while very spotted, gives promise of further development. Exploration in this field is impracticable in winter but in summer can be prosecuted with success in spite of the great lack of water, the available supply of which is derived principally from snow scraped up in the winter and conserved in pits. The inhabitants of the region are wandering tribes living in tents. They are peaceful and disposed to aid the exploration.

In Galicia deep boring is tending to check the decline in the oil supply and the exploitation has been actively carried forward in all regions where indications have been noted in the past. It is probable that the Government of Hungary will develop the gas wells in the region of Kisarmas.

In Rumania oil production continued active in spite of the very severe fire in the Moreni field. The chief contribution to the industry by the Government was the development of a pipe-line system from the producing fields to Constanza, on the Black sea.

In Japan production was greatly helped by the introduction of the rotary system of drilling.

Building Materials in Colorado, California, and Montana

Descriptions of granite deposits near Gunnison, Colorado, which are being quarried for building stone, of deposits of ornamental marble near Barstow, California, and of clay deposits in northeastern Montana constitute advance chapter K of Bulletin 540 of the U. S. Geological Survey. These three brief reports are written by J. F. Hunter, R. W. Pack, and C. M. Bauer, respectively.

The Colorado granite deposits are now being developed. The marble deposit in California is stated to be practically undeveloped, though the surface showings, in the opinion of Mr. Pack, are promising and are worthy of careful exploratory work.

The Montana clay deposits, examined by Mr. Bauer, are believed to be suitable for brickmaking, as well as for tile.

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Company Reports

The San Francisco, Napa & Calistoga Railway has applied to the California Railroad Commission for authority to issue $33,000 bonds for the purpose of paying indebtedness.

The California Railroad Commission has granted authority to the Mount Whitney Power & Electric Co. to issue $250,000 of its 6% first-mortgage bonds. This block had previously been purchased by Louis Sloss & Co., subject to the approval of the Commission. The offering price on the last block of this issue was par and interest.

The California Railroad Commission has granted authority to the Coast Valleys Gas & Electric Co. to issue $114,000 in bonds. The money is to be used to pay existing indebtedness of the company.

The Santa Clara Valley Water Co. has applied for authority to issue notes in the sum of $2500 to refund existing indebtedness.

The California Railroad Commission has denied the application of the Pacific Light & Power Corporation to issue $1,720,000 in bonds. The company desired to use these bonds for the purpose of refunding a portion of its sinking fund and for the reimbursement of its treasury for moneys expended. The application was to issue $497,000 in bonds to refund sinking fund payments and to issue $1,233,000 in bonds to reimburse the treasury.

In denying the application the Commission states that a sufficient showing has not been made, and states that the company may make a supplemental showing, when the matter will be again considered by the Commission. The denial, therefore, does not foreclose the company in this proceeding.

The California Railroad Commission has granted authority to C. A. Erwin to convey to the Winters Gas Co. a gas franchise to operate within the city of Winters, Yolo county. The Commission has also authorized the Winters Gas Co. to issue stock to the amount of $21,300 for the purpose of building a gas plant.

The Tulare County Power Co. has applied to the California Railroad Commission for permission to issue $80,000 stock and to apply the proceeds toward the construction of additional transmission lines into the orange belt of Tulare county.

The Pacific Gas & Electric Co. has reported for the 12 months ended October 31, 1913, showing about 3% earned on the common stock after carrying $800,000 to sinking fund. Gross earnings for the year were $15,866,707. The year reported includes two months in the calendar year of 1912. As the months of November and December should run ahead of the same months last year, it is likely that the prediction made last May that the gross revenue of the company in 1913 would reach $16,000,000 is likely to be fulfilled. The company reports as follows:

Gross revenue		$15,866,707
Op. ex., taxes, maint..	$9,288,011	
Interest	4,192,920	
Preferred dividend ...	600,000	
		14,080,931
Surplus		$ 1,785,776

The foregoing surplus amounts to 5.56% on the common stock. Last year the sinking fund was not charged against earnings, but it is understood the company will pursue this policy in the future. The requirements for this purpose are about $800,000, being 1% of all bonds outstanding, including underlying issues.

The interest is figured for the year on all issues, although only a part of the $5,000,000 notes have been outstanding for a full year, and this item would be subject to some reduction. After all charges, the balance for the common stock was about 3 per cent.

The California Railroad Commission has extended for six months the effective date of its order authorizing the Southern California Utilities Co. to issue $10,000,000 of bonds. The Southern California Utilities Co. proposes to use the proceeds from the sale of bonds for the purpose of acquiring large areas of land in Riverside county, and developing in connection therewith extensive hydro-electric and irigation projects. The authorization as originally given expired on December 1, 1913. It is now extended to June 1, 1914.

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Book Reviews

REINFORCED CONCRETE CONSTRUCTION. Vol. II. By George A. Hool. McGraw-Hill Book Co., New York. P. 659. Index. For Sale by *Mining and Scientific Press*. San Francisco. Price $5.

This is the second of a series of three volumes dealing with the general subject of reinforced concrete construction. The first, covering the fundamentals, was reviewed in the issue of September 1912. The second is given to retaining walls and buildings, and covers the subject in exhaustive detail. The first part dealing with retaining walls is subdivided into chapters on Theory of Stability, Design and Construction. The second part deals with buildings, the first section including chapters on Floors; Types of Reinforcement; Roofs; Columns; Foundations; Walls and Partitions; Stairs; Elevator Shafts; Contraction and Expansion; Shear and Moment Considerations in Continuous Beams; Eccentric Load Consideration in Columns; Wind Stresses; Design of a Factory Building, and Example of a Building Design including the specifications. The second section contains chapters on Materials; Forms; Bending and Placing of Reinforcement; Proportioning Mixing and Placing of Concrete; Finishing Concrete Surfaces; Waterproofing of Concrete, and Construction Plant. The third section covers Estimating Unit Costs; Estimating Quantities; and Example of an Estimate for a Concrete Building.

The above summary may serve to convey an idea of the thoroughness with which the subject has been covered. The text is much more than descriptive, but goes extensively into the mathematics and established practice with regard to the principles of design. Many typical specimens of design are given from the various component parts to the complete structure. As a whole this book is excellent, and in view of the remarkable advance during recent years in the application of reinforced concrete to structures of all kinds, will prove to be almost an essential to every engineering library.

A TREATISE ON ROADS AND PAVEMENTS. By Ira Osborn Baker. John Wiley & Sons, New York. P. 688. Index. For Sale by *Mining and Scientific Press*, San Francisco. Price $5.

Since the first edition of this book was issued in 1902, road building has been subjected to two important changes. The great increase in automobile and motor truck traffic has brought about the necessity for a type of road surface that would meet the new conditions. The development of the portland cement industry also has introduced a new factor in road construction methods and, as stated in the author's preface, these two new factors have necessitated a new edition in which due cognizance is taken of present day conditions. The general subject in itself is a big one. There are nearly as many types of road in existence as there are road districts. The author has brought to bear a comprehensive knowledge of the subject and aided by an unusual facility of expression has prepared one of the best, if not the best, general treatise on roads and pavements that has been offered to road builders. Part I covers the general subject of Country Roads and contains chapters on Road Economics; Road Location; Earth Roads; Gravel Roads; Broken Stone Roads; Miscellaneous Roads; Equestrian Roads; and Horse Race Tracks. Part II covers Stone Pavements and contains chapters on Pavement Economics; Street Design; Street Drainage; Curbs and Gutters; Pavement Foundations; Asphalt Pavements; Brick Pavements; Cobble Stone Pavements; Stone Block Pavements; Wood Block Pavements; Comparison of Pavements; Side Walks; Bicycle Paths and Race Tracks; Automobile Roads and Concrete Pavements.

SEWER DESIGN. By H. N. Ogden. John Wiley & Sons, New York. P. 240. Index. For Sale by *Mining and Scientific Press*, San Francisco. Price $2.

This is the second edition of Mr. Ogden's work, the first having been published in 1899. The text has been rewritten and new matter added since the appearance of the first edition. The following is a summary of chapter titles: General Considerations; Preparatory Maps and Data; Excessive Rains; Proportion Reaching the Sewers; Relation of Density to Percentage; Mathematical Formulae; Estimating Future Population; Amount of Sewage per Capita; Ground Water Reaching Sewers; Grades and Self-Cleansing Velocities; Development of Formulae for Flow; Kutters Formula; Sewer Diagrams; Use of Diagrams; Sewer Plans; Sewer Cross Sections; Flushing, and Use of Tanks.

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Engineering News

Petroleum

San Francisco, Cal.—The Railroad Commission has established a wholesale rate on natural gas piped from the Kern county oilfields into Los Angeles county at 14c. per 1000 cubic feet.

Bakersfield, Cal.—The Standard Oil Co. has commenced to build a tank farm 3 miles from Buena Vista lake. Twenty-eight tanks will be erected with a total aggregate capacity of 1,000,000 bbl. This farm will be used for the storage of heavy oil.——The Standard Oil Co. has commenced work on two new pipe-lines; one a 12-in. line between Bakersfield and Mendota, and the second an 8-in. line from Northam to El Segundo.

La Habra, Cal.—The gasoline plant operated by Hurley, Smith & Collins, operating on the lease of the Amalgamated Oil Co., is now turning out 1800 gal. of gasoline per day.

Los Angeles, Cal.—Statistics concerning the manufacture of gasoline from casinghead gas during 1912 are as follows:

	No. of operators.	No. of plants.	Daily cap., gal.	Cents per gal.	Gas used, cu. ft.	Av. yield, gal.
West Virginia	66	97	22,366	9.6	1,972,882,212	2.8
Pennsylvania	69	83	10,524	10.6	722,730,117	2.8
Ohio	25	43	7,791	10.1	576,123,700	2.98
Oklahoma	11	13	11,910	6.3	701,044,300	2.25
California	7	7	6,669	10.8	600,743,000	1.7
Illinois, Colorado, New York	7	7	2,008	10.8	114,273,000	3.4
Total	185	250	61,250	9.6	4,687,796,329	2.6

The total production of oil in the California fields during 1913 was as follows:

	Barrels.
January	7,566,789
February	7,207,198
March	7,986,407
April	7,927,041
May	8,049,715
June	8,030,111
July	8,427,081
August	8,812,793
September	8,655,000
October	8,236,649
November	8,367,151
December	8,500,000

It is stated that the General Petroleum Co. has contracted with the Mays Consolidated Oil Co. for its output from the Midway field, amounting to about 65,000 bbl. per month.——The California Oil Fields, Ltd., which is owned by the Royal Dutch-Shell interests, has placed the following contracts for steel storage tanks in the Coalinga field, of an aggregate capacity of 1,100,000 barrels: Petroleum Iron Works of Sharon, Pa., for the construction of five steel storage tanks of 55,000 bbl. capacity each, to be erected on the southwest quarter of 4-20-16, for $16,400 per tank; Lacey Manufacturing Co., of Los Angeles, for ten steel tanks of 55,000 bbl. capacity each, at $16,250; Llewellyn Iron Works, of Los Angeles, for five steel storage tanks of 55,000 bbl. capacity at $15,350 per tank. The fourth contract is with the Shattuck & Nimmo Warehouse Co. for unloading and hauling of material and camp equipment, and grading and excavating for tank sites, for approximately $15,393. The four contracts call for expenditures as follows: Sharon contract, $82,000; Lacey contract, $162,500; Llewellyn contract, $79,250; hauling and grading, $15,393; total, $339,143.

Fillmore, Cal.—The Montebello Oil Co. is preparing to install a plant for the manufacture of gasoline from natural gas on its property near Fillmore. The plant will have an aggregate capacity of 800,000 cu. ft. of natural gas per day.

Railways

San Francisco, Cal.—The following contracts have been let for materials for the extension of the municipal street railroad:

1. Furnishing and delivering steel, rails, rail joints, and fastenings, United States Steel Products Co., whose bid under Proposition No. 1 amounts to $145,514.22, and under Proposition No. 2 to $159,118.98. The

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United States Steel Products Co. will be informed later as to whether the Board of Public Works desires the contract to be entered into under Proposition No. 1 or No. 2. The Board of Supervisors requested to set aside $166,000 to meet the expenses of executing this contract, which is estimated as follows: $159,118.98 contract price, $4500 possible bonus, and $2381.02 cost of inspection.

2. Furnishing and delivering steel tie-rods and nuts, Payne Bolt Works of San Francisco, $3514.15.

3. Furnishing and delivering tie plates, brace plates, and rail braces, Eccles & Smith, f.o.b. San Francisco, $15,164.32 contract price, and $335.68 expense of inspection.

4. Furnishing and delivering rail spikes, United States Steel Products Co., $2550.

5. Furnishing and delivering redwood cross-ties, Caspar Lumber Co. of San Francisco, f.o.b. wharf at San Francisco, $37,990 contract price, $1010 cost of inspection.

7. Sections A and B, for furnishing and delivering track special work, United States Steel Products Co., 863,500 lb. for $87,738 f.o.b. cars at place of manufacture. The Board of Supervisors was asked to set aside $97,000 to meet the expenses of executing contract, estimated as follows: Contract price, $87,738; possible bonus, $6600; expenses of inspection, $2662.

13A. For furnishing and delivering car bodies for 100 or more street-cars, Jewett Car Co., whose bid of $2800 each, or $280,000 for 100 car bodies delivered f.o.b. cars at place of manufacture, was the lowest. The Board of Supervisors was asked to set aside $300,000 to meet the expenses of contract, estimated as follows: Contract price, $280,000; possible bonus, $15,000; expenses of inspection, $5000.

13B. Furnishing and delivering trucks for 100 or more street-cars, Baldwin Locomotive Works, whose bid of $580 for each set of trucks delivered f.o.b. cars at place of manufacture, or $58,000 for 100 sets, was the lowest. Supervisors to set aside $62,000 as follows: Contract price, $58,000; possible bonus which the contractor may earn, $3000; cost of inspecting, $1000.

13C. Furnishing and delivering motor equipment for 100 or more street-cars, Westinghouse Electric Manufacturing Co., whose bid of $2176 for each motor equipment, using Westinghouse 306, box-framed, 50 to 60-hp. street railway motors, with type H.L. control and emergency device, or $217,600 for all of the motors, was the most desirable. Supervisors to set aside $236,000 to meet the expenses of executing contract, estimated as follows: Contract price, $217,600; possible bonus, $16,600; cost of inspection, $3400.

13D. Furnishing and delivering air-brake equipment for 100 or more street-cars, Westinghouse Traction Brake Co., whose bid of $210 for each air-brake equipment, or $21,000 for all. Supervisors to set aside $23,000 to meet expenses of contract, as follows: Contract price, $21,000; possible bonus, $1500; and cost of inspection, $500.

The Crocker Estate, with offices in the Crocker building, this city, will build an electric railway, 3½ miles long, for the purpose of providing transportation facilities to its large real estate holdings in San Mateo county. Edison battery cars will be used.——Articles of incorporation for the San Francisco Peninsula Railroad Co. are about to be filed. The project contemplates the construction of a road from San Francisco to Monterey, with a branch line to Santa Cruz, a distance of approximately 100 miles. Charles L. Brown is attorney for the new company, and with him are associated Lee Landis, traffic manager for the Tidewater & Southern railroad, and M. M. Stern of the Anglo & London, Paris National bank of this city.——The Railroad Commission has authorized the Sacramento Electric Railroad Co. to construct the first unit of its proposed electric railway from Dixon, Solano county, south to a connection with the Oakland, Antioch & Eastern railroad. The distance is 12½ miles, and the estimated cost $228,000. The officers of the company are: C. L. Donohoe, president; H. W. Manor, vice-president; J. Reith, Jr., treasurer; E. L. Sisson, secretary; A. C. Huston, attorney.

Stockton, Cal.—A deed has been filed recording the transfer by the San Joaquin Valley Electric railroad of all of its property to the M. McCormick Co. It has rights-of-way from Stockton to Modesto.

Salt Lake City, Utah.—The Salt Lake & Ogden railroad and the Salt Lake & Utah railroad will expend $100,000 for the construction of joint car-barns on First West South street, between Third South and Fourth South streets.——The Commercial Club is discussing plans for the construc-

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tion of a spur track to Fort Douglas. Wesley King is chairman of the committee having the matter in charge.——Construction work on the extension of the Salt Lake route from Delta into the adjacent farming territory to Hinckley was commenced on January 15.

Nelson, B. C.—The voters have given an affirmative vote in favor of taking over the Nelson street railroad system; $16,000 has been appropriated for the purchase and $30,000 for maintenance.

Toppenish, Wash.—It is stated that the new Northern Pacific branch line to Fort Simcoe will be extended to White Swan early in the spring. In all 11 miles of additional railroad will be constructed.

Tacoma, Wash.—The citizens rejected a proposed $87,000 bond issue for the purpose of building a street-car line over the tideflats manufacturing district.

Washington, D. C.—The Department of Agriculture announces that 1,000,000,000 ft. of lumber from the Kaibab National Forest in southern Utah and northern Arizona will be sold, with authority for the construction by the purchasers of 200 miles of railroad. Bids will be received up to the middle of June this year, and three years will be allowed the contractors for building the railroad.

Streets and Roads

San Francisco, Cal.—Plans for widening the completed portions of the California state highway to a minimum width of 21 ft. have been presented to the California Highway Commission by A. B. Fletcher, state highway engineer. Gravel or broken stone shoulders 3 ft. wide on each side of the paved roadway are to be built, thus increasing the width by 6 ft.——The Board of Public Works has awarded the following contracts: Curbing and paving the intersection of Ninth street, San Bruno avenue and Division street, to G. W. McGinn & Co., for $10,003.45; curbing and paving Ninth, between Division and Brannan streets and San Bruno avenue, between Division and Alameda streets, to R. Nugent for $3338.40 and $2850.85, respectively; constructing a sewer in Ashton avenue, between Grafton and Ocean avenues, to William Heafy for $3623.90; improving Thirteenth avenue, between Cabrillo and Fulton streets, to Owen McHugh for $2400. The Board has called for bids for the construction of the Washington Irving School on Broadway, between Sansome and Montgomery streets, the cost estimates being: General construction, $80,000; heating and ventilating system, $3000; plumbing and gasfitting, $6000; electric wiring, $2500; brick work, $12,000.

Sacramento, Cal.—The California Highway Commission will receive bids up to February 2 for construction work as follows: Eldorado county, from Eldorado to Placerville, about 6½ miles in length, to be built of water-bound macadam. Tuolumne county, from the westerly boundary to Keystone, about 10.8 miles in length, to be graded. Tulare county, from Traver to the northerly boundary, about 5.3 miles in length, to be built of portland cement concrete. Kern county, from Lerdo to Famosa, about 8.9 miles in length, to be built of portland cement concrete. Kern county, from Bakersfield to Lerdo, about 10.1 miles in length, to be built of portland cement concrete. San Bernardino county, from the westerly boundary to Upland, about 1.7 miles in length, to be built of portland cement concrete. Ventura county, from Ventura to Sea Cliff, about 7.7 miles in length, to be built of portland cement concrete. San Luis Obispo county, from Santa Margarita to Atascadero creek, about 8.4 miles in length, to be built of portland cement concrete. San Luis Obispo county, from Paso Robles to the northerly boundary, about 10.6 miles in length, to be built of portland cement concrete, Santa Cruz county, from the easterly boundary to Glenwood, about 5.7 miles in length, to be graded.——Wright and Kimbrough are preparing to lay 2654 ft. of 6-ft. cement sidewalk on their tract, No. 24.

Spokane, Wash.—J. W. Strack, county engineer, has filed his annual report showing that surveys and preliminary plans have been prepared for the expenditure of about $500,000 on county roads during 1913, including in all 53 miles of permanent highway, and plans and preliminary surveys have been made for 19 miles of extensions. Distribution of costs are as follows:

17.75 miles of permanent highways now under contract for $168,540, of which $66,933.24 has been expended.

11.60 miles of permanent highways have been graded by the townships under the supervision of this office at an approximate cost of $10,000. These roads will be ready to receive bids for surfacing in the spring

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of 1914. Estimated cost, $55,000.

19.50 miles of permanent highways will be ready to receive bids early in 1914. Estimated cost, $170,000.

4.50 miles of Sunset boulevard were resurveyed and resurfaced at a cost of $19,608.96.

Curb and hand rail were placed on Sunset boulevard, costing $1386.

Total engineering cost for surveys and supervision of construction of permanent highways, $11,007.90.

The townships during the year called on this office for stakes, etc., for the improvement of 12 miles of road under the permanent highway standards. The cost to this office was $614.71.

69.57 miles of township roads were surveyed at a cost of $1770.78.

The Trent viaduct and fill, separating the grades of the county road and the railroads at Northern Pacific subway, was designed and built at a contract price of $19,128; engineering cost, $663.72.

The annual bridge inspection cost $249.70.

Field and office supplies, $903.83.

The automobile belonging to this department was driven 16,000 miles at a cost of $1649.12.

Clarkston, Wash.—Plans adopted by the City Council provide for extensive street improvements along Main, Sixth, and Seventh streets.

North Yakima, Wash.—The Yakima County Commission is preparing plans for a system of continuous permanent highways from North Yakima to Moxee City, to Naches City, to Selah, and for a distance into the Wenas valley, to Cowiche valley, to Wiley City, and down the Yakima valley to Mabton and Grandview, where it will connect with a road now under construction by the Benton county commissioners to and through Prosser, is the end toward which the Yakima County Commission is now working. In addition the Commission has appropriated $10,000 for a highway to the Kittitas county line and the Kittitas county commissioners have promised a yearly appropriation of $2500 to construct the thoroughfare through to Ellensburg.

Lewiston, Idaho.—The County Commissioners have granted a petition presented by residents of the Lewiston Orchards asking that an election be authorized for the creation of a highway district. The area includes 11,500 acres that has an assessed valuation of $1,911,756. A hard-surface highway is to be built.

Wallace, Idaho.—The City Council has proposed the establishment of paving district No. 2, to include all of Fifth, Sixth, and Seventh streets; Hotel street from the White & Bender warehouse to the railroad tracks; Bank street to Fifth; Cedar street to Fourth; Pine street to Fifth, and all intersecting alleys. The territory covers, with district No. 1, all of the business district east of Fourth street, with Cedar street paved to Fourth. Advertisements for bids for the paving of district No. 1 will be made in the near future. City Engineer Merriam, who has just returned from a tour of inspection of various cities, reported that from his investigations bitulithic was the most desirable for this city. Definite action will be taken at the next meeting of the council.

Coeur d'Alene, Idaho.—The County Commissioners will submit to the voters a bond issue amounting to $12,000 to provide funds for new roads. The State Highway Commission proposes to build 44 miles of road in co-operation with the county.

Sand Point, Idaho.—The County Commissioners will appropriate $17,000 to co-operate with the United States Government in building new roads in certain national forests. ——Mr. Cave, city engineer, has made a report upon the proposal to repave First avenue and Cedar streets.

Boise, Idaho.—The State Highway Commission has officially designated the trunk lines for the state highway system: These lines are 1262 miles in length and traverse 27 counties, as follows: South Idaho east and west road, the Idaho Pacific; north Idaho east and west road, the Northern Pacific; highway to McCammon, Idaho-Utah; highway from Boise to Sawtooth range, Idaho Central; eastern north and south line, Idaho-Montana. The $200,000 unsold bond issue was apportioned among the counties. Theodore Turner was instructed to go to Washington and confer with the Department of the Interior to secure, if possible, $100,000 for use on the Idaho system. A state highway engineer was employed for a term of one year. The proceeds of $10,000 worth of highway bonds was voted to Blaine county. The Idaho Falls-Yellowstone Park highway was officially declared part of the Idaho system and $18,000 was voted in bonds for its construction. The Commission decided to consider construction of trunks of the sys-

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tem in the following order: (1) New Meadows to Grangeville; (2) Olds Ferry to eastern boundary of state; (3) St. Regis pass to Spokane, north Idaho; (4) Idaho Falls to Yellowstone Park; (5) Salmon City to Gibbonsville; (6) Idaho-Montana highway, north from Idaho Falls. The bond issue was apportioned as follows: Shoshone, Kootenai, Latah, Nez Perce, Bannock counties, $12,000 each; Lewis, Bear Lake, Bingham counties, $5000 each; Washington, Bonner, Godding, and Twin Falls, $10,000 each; Idaho and Ada counties, $15,000 each; Elmore and Cassia counties, $7500 each; Lincoln and Power counties, $8000 each; Adams, $7000; Boise, $1000; Bonneville, $3500; Lempi, $6000; Fremont, $14,500; Minidoka, $3000; Franklin, $4000.

Salt Lake City, Utah.—The County Commission has decided to call a special election to submit to the voters a proposition to issue $1,000,000 in bonds for road improvements. A limited amount of permanent highways will be built rather than to improve all of the roads with temporary construction. About 58 miles of main trunk lines will be built, and the type of construction will include a portland cement concrete base, while the surfacing will be determined later. February 25 is the date fixed for the election.——Richard P. Morris, commissioner of streets, has given the following summary of street work for 1914: Improvements already authorized for the year will cost approximately $50,000. These include the paving of Second South street west to the Jordan river at a cost to the city of $20,000, the paving of one block on Fourth South street to connect the new Denver & Rio Grande viaduct with the paved district at a cost to the city of $3000; the covering of the Ninth South canal for four blocks at a cost of $20,000, and the building of a storm sewer on Fifth South street from Sixth West street to the Jordan river at a cost of $4500. In addition to these, Mr. Morris will recommend the paving of Thirteenth East street from South Temple to Fifth South, and thence east to Mt. Olivet cemetery; the paving of State street from Tenth South to Eleventh South and Ninth South from Fifth East to Ninth East. The latter extension would connect the Ninth East boulevard with the Fifth East paving. These improvements, if authorized, will cost the city another $50,000. A total of about $1,250,000 will be expended for this work, and of this amount the city will spend approximately $200,000.——Sylvester Q. Cannon, city enginer, gives the following summary of work done in the engineering department during 1913: The total cost of improvements completed was $846,256.78, in return for which there was constructed and entirely completed 1.47 miles of sheet asphalt pavement, 2.23 miles of rock asphalt pavement, and 0.3 mile of concrete base, at a cost of $240,515.29; 24 miles of sidewalk, at a cost of $94,553.63; 13.8 miles of curb and gutter, at a cost of $141,655.63, and 12 miles of sewer laterals at a cost of $101,029.56. The report calls attention to the practical completion of the Denver & Rio Grande viaduct at Fourth South and Fourth West streets, at a cost of $150,000; the beginning of work on the Lake Phoebe dam, to cost $66,000; the construction of the public comfort stations, the addition of a new sewer pumping unit, and the construction of storm sewers. Two miles of storm sewers were laid at a cost of $26,797.74, which exceeds the total amount expended heretofore. Total receipts of the engineering department for the year were $9423.22.——E. R. Morgan, state road engineer, has recommended that bitulithic surfacing be used for the new highways to be built under the $1,000,000 bond issue.

Washington, D. C.—A bill has been introduced appropriating funds for federal aid in road building for 1914 as follows: Arizona, $55,000; California, $503,750; Colorado, $201,250; Idaho, $112,500; Montana, $128,750; Nevada, $42,500; New Mexico, $100,000; Oregon, $121,500; Utah, $88,750; Washington, $262,500.

Miscellaneous Engineering Construction

San Francisco, Cal.—The Standard Oil Co. has placed a contract with the Union Iron Works for the construction of an oil tanker. The vessel will be named the *J. A. Moffett*. The length over all will be 435 ft. 4 in.; beam, 54 ft.; draft, 31 ft. 6 in.; carrying capacity, 9562 tons. The propelling machinery includes a vertical inverted marine type quadruple-expansion engine which will develop 3000 indicated horse-power at 85 revolutions per minute.

Berkeley, Cal.—The City Council has approved the report of J. J. Jessup, city engineer, for harbor improvements and has

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passed the necessary resolutions for calling an election to authorize a bond issue of $1,000,000. Complete bids calling for the construction of the proposed municipal tunnel to connect the outer harbor with the main business streets have been submitted. The lowest bidder was Shattuck, Edinger & Co., of San Francisco, whose offer was $232,084.16; the highest bidder was McArthur Brothers Company, of the same place, who estimated $343,000 as their figure. The contract calls for the removal of 146,000 cu. ft. of earth and lining the bore with portland cement concrete.

Sacramento, Cal.—The legality of the bond issue of $1,032,000 for new sewers has been attested by New York attorneys and this removes the last obstacle in the way of commencing construction upon the Sutterville levee. Rights of way have been secured for the levee complete, except for a fraction of an acre. It is stated that the Southern Pacific company will build a levee in conjunction with the levee work that is now being done in charge of W. H. Kirkbride, engineer; $125,000 is to be expended for this work.

Grass Valley, Cal.—The City Council has rejected the proposal to issue $30,000 in bonds for the improvement of the water, sewer, and fire systems.

Yuba City, Cal.—J. C. Albertson, of the Sutter county Board of Supervisors, is preparing data for the proposed new structure to replace Long bridge, destroyed by fire last fall.

Colusa, Cal.—The Board of Supervisors is considering a proposal to issue bonds for constructing a new Hall of Records and various bridges and culverts throughout the county, and also a concrete bridge over the low lands between Colusa and Williams.

Vancouver, B. C.—It is stated stated that the plans made by the city for the east end viaduct have been approved by the Great Northern railway. Bids will be called in a few weeks. A. P. Hueckel is engineer for the city.

Washington, D. C.—The Chief of Engineers of the U. S. Army has estimated that $41,483,895 will be required for river and harbor work in 1914. Of this amount the following covers the appropriation for western states: California: Los Angeles harbor, $25,000; San Francisco harbor, $9000; Oakland harbor, $98,000; San Pablo bay, $40,000; Humboldt harbor and bay (rebuilding jetties), $525,000; Sacramento and Feather rivers, $25,000. Oregon: Coquille river, $49,000; entrance to Coos bay and harbor, $50,000; Coos river, $3000; Siuslaw river mouth, $5000; Tillamook bay and bar, $207,000; Nehalem bar and entrance to bay, $116,175; Snake river, $10,000. Washington: Cowlitz and Lewis rivers, $16,000; Puget sound and tributary waters, $25,000; waterway, Puget sound to Lakes Union and Washington, $375,000; Skagit river, $10,000; Columbia river, Bridgeport to Kettle Falls, $25,000. Hawaii: Honolulu harbor, $125,000; Hilo harbor, $100,000. Columbia river: Improving mouth, $1,000,000; improvements below Portland, $300,000; at Cascades, $10,000; at Three-Mile rapids, $425,000; upper Columbia and Snake rivers, $3000; Willamette and Snake rivers, $30,000; Willamette river above Portland, $30,000; Clatskani river, $1000.——The U. S. Reclamation Service has placed orders for dredging equipment for the new Jackson dam for the Snake River Storage Project, Idaho, as follows: For furnishing one 12-in. manganese steel-lined centrifugal dredging pump, the Morris Machine Works, Baldwinsville, N. Y., contract price, $4115; and also contract with same company for furnishing one 6-in. high pressure centrifugal pump, direct connected to a 25-hp. vertical compound noncondensing engine, contract price, $610. The company will also knock down and crate the engine for the 70-mile wagon haul over rough mountain road from railroad to dam for $60. For one 4-drum 20-hp. hoisting engine, the Lenher Engineering Co. of New York, contract price, $1050. For six 40-hp. Scotch marine type internally fired boilers, Murray Iron Works, Burlington, Iowa, contract price, $4200. For two boiler-feed pumps, 30 gal. per minute capacity, the Hallidie Machinery Co., Seattle, Wash., contract price, $195.80. Jackson Lake dam, built on the headwaters of Snake river in Wyoming, will store 400,000 acre feet of water primarily for use on the Minidoka irrigation project in southern Idaho, assuring an ample supply at all times. By an arrangement with the Carey act project at Twin Falls, water stored in this reservoir is now also used to supplement the original supply of that project.

Power, Gas, and Electricity

San Francisco, Cal.—The Railroad Commission has authorized the Pit River Power

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Co. to operate a hydro-electric plant in and about Burney Falls, Shasta county, California, and to issue $90,000 in preferred stock to provide funds for constructing purposes.—The State Water Commission reports having issued 20 permits for power purposes during the first year and a half of its existence. These permits involve a contemplated expenditure of $16,198,226.50. Eleven of these permits were afterward revoked, leaving a total estimated cost of projects now under development of $2,778,191. In all, 64 applications have been made, of which 11 were rejected for furnishing incomplete data; 5 because good faith was not shown; and 4 applications were withdrawn. The following list shows projects in operation and permits revoked: Globe Consolidated Co., 25 cu. ft. on Canyon creek to develop 1500 hp. at a cost of $19,703; Empire Water Co., 200 cu. ft. on Coyote creek to develop 1500 hp. at a cost of $130,000; Eby, Whisner & Bruener, 764 cu. ft. on the North Fork of the Feather river, to develop 60,000 hp. at a cost of $360,000; Salve Olsen, 25 cu. ft. on the North Fork of the Feather river, to develop 100 hp. at a cost of $7500. E. O. McGrath, 20 cu. ft. on Lone Pine creek, to develop 1000 hp. at a cost of $95,671; E. T. Thompson, 200 cu. ft. on Volcano creek to develop 100 hp. at a cost of $4000; C. A. Loone, 230 cu. ft. on East Walker creek to develop 10,420 hp. at a cost of $220,317.50; and Birchville Mining Co., 625 cu. ft. on Weaver lake, to develop 300 hp. at a cost of $30,000. The following permits have been revoked by the Commission: Little Rock Power & Water Co., 20 cu. ft. on Little Rock creek, to develop 2113 hp. at an estimated cost of $400,705; Emma Blanche Mining & Power Co., on Bull creek, estimated cost $10,000; Howell, Wheeler & Wildes, Butano creek, estimated cost $17,000; Trinity Exploration Co., Coffee creek, estimated cost $50,000; B. C. Merkinon, Fall river, estimated cost $100,000,000; Black Rock Development Co., Goodale creek, estimated cost, $44,100; W. A. Selley, Rawson creek, estimated cost $21,000; Sierra Park Power Co., San Joaquin river, estimated cost $1,582,600 (company dissolved); James Howen, Smith river, estimated cost $3,000,000; James Howen, South Fork, Smith river, estimated cost $4,000,000; and James H. Wilkins, Trinity river, estimated cost $3,313,530.

Alta, Cal.—A landslide inflicted minor damages upon the new Drum power-plant of the Pacific Gas & Electric Co., on January 2.

Bishop, Cal.—The Bishop-Lundy transmission line of the Pacific Power Co. has been completed. The line is 66 miles in length and extends from Plant 5 to the power plant at Jordan, Mono county. This company is affiliated with the Nevada-California, Southern Sierras, and Bishop Light & Power Co. The connecting lines constitute one of the longest transmission systems in the world. The southern terminus is to be in Imperial valley. South of this point will be the older power line 238 miles long with 140 miles of extensions. North, a 66-mile line to Jordan connects with the Pacific 150-mile line into Nevada, making about 600 miles of transmission line, in addition to the original Goldfield and Tonopah system over 100 miles in length, into which electrical energy can be sent from any of the connected plants. The power generating plants include the Jordan, 3000 kw.; at Bishop Creek, Plant No. 2, 6000 kw.; Plant No. 3, 6750 kw.; Plant No. 4, 6000 kw.; Plant No. 5, 1500 kw.; Plant No. 6, 2000 kw.; and the San Bernardino steam plant, 5000 kw. It is stated that prospective development work includes provision for three plants on Big Pine creek to be installed in the near future.

Spokane, Wash.—A contract has been closed by the Culbertson-Grote-Rankin Co. for power with the Washington Water Power Co. The contract represents a total of $12,000 per year for 5 years.——A franchise has been applied for by H. A. Flood, president of the Trustee Co., for the installation of a downtown heating and electric plant to be built at a cost exceeding $300,000.

Lapwai, Idaho.—The Lewiston Electric Light & Power Co. has applied for a franchise for the installation of an electric lighting system.

Boise, Idaho.—Due to a disagreement among stockholders, the Idaho-Oregon Light & Power Co. has gone into the hands of a receiver. W. J. Ferris of La Crosse, Wisconsin, has been appointed by the Federal District Court of Idaho to act as receiver. It is understood that the receivership will continue until the bondholders can reach some agreement or the property is sold at a foreclosure sale.

Great Falls, Montana.—A mortgage has been filed whereby the Montana Power Co.

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places a lien upon its properties in this state to the extent of $75,000,000 in favor of the Guaranty Trust Co. of New York. This mortgage is given as security for certain bonds issued and to be issued.

Vancouver, B. C.—The Western Canada Power Co., with offices in this city, will add two 13,000-hp. hydro-electric generating units to its present plant. One of these will be installed this spring and the other early in 1915. The present plant of the Company includes two units capable of generating about 25,000 hp. The additional plant and equipment for the new unit, including installation, will involve an expenditure of about $500,000.

Irrigation and Water Supply

San Francisco, Cal.—The State Water Commission has granted permission to the Yolo Water & Power Co. to construct works for utilizing the waters of Clear lake for power purposes, thus settling a dispute between the Company and the irrigationists and riparian owners that has been pending in the courts for some months. The completion of the dam will be carried through as quickly as possible, the power-plants installed at Rumsey and Capay to give a development of 45,000 horse-power.

Richmond, Cal.—The newly organized water district will install a pumping plant on the Sacramento river at Tolands landing. Water will be conveyed via Antioch in a 36-in. pipe to a reservoir back of Martinez. A filter plant at this point will deliver pure water into the storage reservoir at an elevation of 250 ft. The water will be distributed to the towns and factories along the bay shore, ending at Richmond. A bond issue has been provided of $1,700,000 to provide for the pumping plants, reservoirs, and main pipe-lines; and $800,000 for the distributing system in Richmond. Fred H. Tibbetts of San Francisco was the consulting engineer retained to report on the project for the city.

Susanville, Cal.—It is stated by Scott McArthur, superintendent of the Lassen Irrigation Co., that the Company's reservoirs will be completed in spring. Fifteen thousand acres of desert land will be reclaimed in this project. Two reservoirs are under construction, one containing 25,000 acre feet and the other 12,000 acre feet, to furnish water for irrigating 20,000 acres.

Red Bluff, Cal.—E. G. Hopson, supervising engineer of the U. S. Reclamation Service, has rendered a preliminary report to the directors of the Iron Cañon Project Association. The report states in brief that a dam of the required height can be constructed with reasonable economy in Iron canyon. Further investigation work is to be carried on and a final report to be rendered in July or August of this year.

Fallon, Nevada.—It is stated that the land embraced within the Truckee Carson irrigation project in Churchill county will be reopened for settlement again in May. This land was withdrawn from entry during the building of the Lahontan dam. D. W. Cole is project engineer.

Yerington, Nevada.—I. L. Ruffner in behalf of a Pennsylvania syndicate is inspecting Smith valley with the object of installing an irrigation system for 15,000 acres of land at a cost of $250,000.

Pendleton, Ore.—H. D. Newell, project engineer for the Umatilla project at Hermiston, has been instructed by the Secretary of the Interior to commence operations upon the west extension at once. E. R. Davis, chief surveyor, has been locating lines for several weeks.

Klamath Falls, Ore.—A rate of 15c. per acre has been determined for water users in the first unit of the Klamath project for 1914.

Colfax, Wash.—It is reported that Ferdinand Bonestadt, engineer for the Palouse project, has located a reservoir site about 6 miles above Elbertson and 1 mile below the mouth of Cedar creek. The river is walled by bluffs 86 ft. high of solid basaltic rock, and a dam 86 ft. high and about 300 ft. long will be built at this point.

Chelan, Wash.—A petition has been presented to the County Commissioners to call an election for the formation of an irrigation district to include 10,000 acres adjacent to Lake Chelan. It is proposed to extend the Wapato project at a cost of $390,994. The new work will include an additional supply line, reservoirs, ditches, and flume of an aggregate length of 22 miles.

North Yakima, Wash.—The contractors have completed canals for the Moxee drainage district at a cost of $60,000. Eleven miles of main canal drain, of which 7 miles is open and the balance is tile drain, have been built to drain an area of 4000 acres. The Chamberlain Construction Co., of Seat-

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tle, was the contractor.——The Washington Irrigation Institute has been organized with a membership of 127. The officers elected were: President, E. F. Benson, of Tacoma; vice-president, L. MacLean, of Spokane; secretary-treasurer, Marvin Chase, of Wenatchee; directors, E. C. Burlingame of Walla Walla, E. M. Chandler of Burbank, George Rodman of Sunnyside, C. W. Johnson of Ellensburg, L. P. Horton of Wenatchee, and R. K. Tiffany of North Yakima.

Quincy, Wash.—At a bond election for the Quincy valley irrigation project $160,000 was voted for the purpose of making a complete preliminary survey of the lands to be served, and the source of water supply at Lake Wenatchee. The lands to be irrigated are about 65 miles from the proposed source of supply.

Salt Lake City, Utah.—The City Council will hold a special election within two months to sanction the bond issue to retire a former issue about to fall due. At the same time a vote will be asked upon water improvements which will involve between $500,000 and $750,000.

Engineer's Note Book

The Load Capacity of Ball Bearings

The load-carrying capacity of radial ball-bearings, according to the practice of the Hess-Bright Mfg. Co. (based on the researches made for it by Professor Stribech), may be determined from the formula:

$$P = knd^2$$

in which

P = load on bearing;
n = number of balls required to fill the races;
d = diameter of balls;
k = a coefficient depending on the type of bearing, the material, and the speed.

For Hess-Bright bearings, in which the radius of curvature of the outer race groove $= \frac{9\,d}{16}$, and that of the inner race groove $= \frac{25\,d}{48}$, separated balls being used, and uniformly distributed load and uniform speed below 3000 r.p.m. being assumed, $k = 9$ (for load in pounds and d in units of ⅛ in.). For full type bearings with the filling opening in one race at the unloaded side, otherwise as above, $k = 5$. For both ball tracks interrupted by filling openings, inelastic cage separators for the balls, or for full ball type, and speeds not over 2000 r.p.m. with a uniform distributed load, $k = 2.5$. For thrust load on a radial bearing of the first type in this tabulation, $k = 0.9$. In general, the larger the number of balls, the smaller the value of k. The radial load bearing is, within the limits stated, practically unaffected by the speed as to its carrying capacity.

Collar thrust bearings are made of three general types. In the first both races are flat; in the second, one race is flat, the other grooved; in the third, both races are grooved. The load-carrying equation given by Mr. Hess is:

$$P = \frac{k_1 n d^2}{\sqrt[3]{S}}$$

in which

P = load on bearing;
n = number of balls;
d = diameter of balls;
S = r.p.m., not exceeding 3000;
k_1 = a coefficient depending on the material and the shape of the ball races.

For the materials used by the Hess-Bright Mfg. Co. and for races having grooves with a cross-sectional radius equal approximately to $0.82\,d$, $k_1 = 25$ to 40 (for loads in pounds and d in units of ⅛ in.). For unhardened steel, such as is occasionally used for very large races and where there is no hammering or sharp blows, $k_1 = 0.5$. When one or both races are flat, k_1 should be reduced to one-fourth of the above value.

The Standard Roller Bearing Co. gives the following load-capacity formulas for ball thrust bearings having a groove in each washer, stating that the ratings obtained from their use are very conservative and give a condition of loading under which a bearing can be guaranteed if properly installed and lubricated. The formula for the light type bearing with 17 balls is:

$$P = 32{,}000\,\frac{nd^3}{a\sqrt{S}}$$

in which

P = load on bearing, lb.;

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d = ball diameter, in.;
n = number of balls;
a = pitch of diameter of the ball grooves, in.;
S = speed of the shaft, r.p.m.

The formula for the medium and heavy bearings having 11 and 9 balls, respectively, is:

$$P = 19{,}200 \frac{nd^3}{a\sqrt{S}}$$

The notation is the same as given above.

Hints on Practice

Cures for Gas-Engine Troubles

Unfortunately, it is usual to find that the majority of those who write upon gas-engine troubles draw upon a large storehouse of theoretical knowledge, picked up in technical schools or other similar sources. They can talk glibly about the calorific values of gases, British thermal units, pyrometer tests, coefficients of friction, strains and stresses, but hitch them on to a refractory gas engine which refuses to start through no visible or apparent reason, and of what value is all their theoretical wisdom then? The possession of a little practical knowledge which has been ingrained as a result of many a painful and muscle-aching experience with the pump or flywheel, combined with the strength of a bull, is much more likely to coax a refractory gas-engine into a good temper than all the high-flown theories ever evolved.

If a gas-engine fails to start at the first attempt, there exists a very good reason. True, the same reason might not apply to the twentieth refusal, but it is either this or another.

If it is essential for designers to be possessed of unlimited theoretical knowledge, those who have the management of a running engine need not worry because they have none. Run the eye over an engine which has been running a couple of hours and settled down to its work. Take a mental note of the temperature of the cylinder jacket water; observe the depth of glow which the ignition tube gives out; watch the timing and frequency of the explosions, and we shall find the conditions perfect. Now, if we could have to hand all these conditions which two hours' running time has made perfect for us, when we want to start first thing in the morning, we should have little cause for complaint. But this is what we do not get. Every condition is unfavorable to a quick start. The cylinder is cold, the ignition tube not the right heat, the mixture bad—all of which need overcoming before perfect running conditions can be obtained. Now, note that we have these several unfavorable factors, all of which are operating against us simultaneously, yet it only needs one to be present to prevent a successful start.

There are many points that need attention in a gas-engine, and the majority of them so apparently unimportant, yet any one of which, if other than normal, is sufficient to account for its non-starting, that need something more than a cursory examination if an engine refuses to start. Chief among these I put the following:

Inoperative governors.
Leaky exhaust valves.
Bad mixture.
Pre-ignition.
Ignition tube not at the correct heat.
Leaky liners.
Cylinder jacket water not at the correct temperature.
Low pressure of gas supply.
Valve settings.
Anti-fluctuator valve sticking.
Inferior oil.

There are, of course, many others, but the writer has found from practical experience that in ninety-nine cases out of a hundred, when an engine refuses to start, the trouble will be found among those enumerated. Now let us deal with these in the order given.

Inoperative Governors.—By inoperative governors I refer to that portion of the mechanism constituting the 'hit-and-miss' motion. This is often at fault owing to the steel strip on the governor-rod not striking truly into the grooved steel block, but slipping off before it reaches the end of the stroke. If this occurs, the gas valve does not open sufficiently to take in its proper supply of gas necessary to enrich the air to make an explosive mixture. Sometimes, too, wear takes place at these points. This, together with additional lost motion due to wear on the joint pins, will bring about the same result. If this be suspected, the blade and strip should be softened and re-

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grooved, and then hardened again. To compensate for any loss of length, the hole into which passes the screw securing the strip is slotted, and the latter pushed slightly forward, a small packing piece being afterward fitted behind the strip in order to prevent it shifting back.

LEAKY EXHAUST VALVES.—This is a trouble perhaps more frequently encountered than any other. A faulty exhaust valve prevents perfect compression, hence a weak charge. Explosions in the exhaust pipe are sometimes caused by a valve which permits some of the compressed charges to escape into this pipe. It is, however, a comparatively easy matter to set at rest any doubts concerning this by pulling the engine round and noting the resistance opposed to the movement on the compression stroke, observing if it is maintained when held in that position. But if there is still a lingering doubt, the exhaust pipe near the cylinder should be disconnected, and it should be ascertained by feel and sound if anything is passing the valve when it is supposed to be closed.

Here, parenthetically, I might add, is a point worth attention. The writer has come across several instances where the exhaust valve, through frequent grinding or facing, will not sit down properly on its seat owing to the radius on the stem directly under the valve fouling the guide hole before the valve actually seats itself. This is a matter easily overlooked, but productive of a deal of trouble.

Any alteration in the length of the exhaust valve due to much grinding or facing of either valve or seat needs to be compensated for by a careful adjustment of the set pin on the cam lever which operates the valve; care being taken that a little slack movement exists between the cam roller and the tappet end of the lever.

BAD MIXTURE.—The ideally perfect mixture is that which is neither too rich nor too weak. Too rich a mixture (that is, too large a proportion of gas to air) brings about violent explosions, which are not conducive to economical running, as undue strains are thus thrown on the working parts of the engine; the wear and tear being correspondingly greater. On the other hand, too weak a mixture, or one not rich enough in gas, causes imperfect and often late firing. To tell an engine attendant that the correct mixture should be ten, eleven, or twelve to one, as the case may be, conveys nothing intelligible to him; he has to make the best of the conditions provided. But what he can do toward securing the most satisfactory results is to make sure that his air-supply box, and the material contained therein, is free to permit an adequate supply of air being drawn through, as the latter sometimes gets choked with dirt and dust. The gas and air valves, too, should be periodically examined, and their stems kept clean and free, as they develop a nasty habit of sticking and refusing to get home promptly to their seats.

PRE-IGNITION.—Several disturbing factors are invariably present in a gas-engine which conduce to pre-ignition, and the writer has been present when several bad explosions have taken place in the exhaust pipe, to the injury of his fellow-beings as a result of this trouble. His experience has been that this is more likely to occur in the case of an engine fitted with electric ignition. Here the trouble is undoubtedly caused by the contacts wearing and getting sufficiently hot to ignite the gases before the spark passes. Or it may be that the contact points become carbonized to such an extent that a spark will freely pass before the contact is broken. With tube ignition, and in the case of engines having a timing valve, it points either to a leaky valve or that the cam or roller actuating it is unduly worn.

When no timing valve is used, and a heated welded tube forms the igniter, pre-ignition may often be prevented by shortening it, say, ¼ in. The surfaces of the combustion chamber, the valve heads, and the back of the piston must be kept free of carbon, otherwise an undue accumulation of this when at a high temperature is also apt to cause pre-ignition.

TEMPERATURE OF IGNITION TUBE.—The temperature of the ignition tube plays a more important part in the efficient running of an engine than many are apt to think. A weak charge might perchance get fired with a tube at the correct heat, but a weak charge and a tube not sufficiently hot will cause a deal of trouble. The writer has been cognizant of cases where the asbestos lining around the inside of the burner has been altogether missing, and the attendant not endowed with sufficient sense to consider it important enough to replace it. A dull tube often induces late

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firing. When this occurs, the exploded gases are simply following up the already forward-moving piston, and its maximum thrusting force at the psychological moment is entirely lost.

LINERS LEAKING.—Water escaping from the jacket into the cylinder is also an evil to be at once scotched. When this occurs, the cylinder walls get chilled, consequently quite an appreciable amount of power is lost owing to a portion of the heat in the gases at the time of the explosion and expansion being dissipated through the walls of the cylinder instead of doing useful work behind the piston. It is useless to tinker with it, trying to stop the leak. Such a course is never effective. Better far to rejoint the liner.

Under this heading a reference might be made regarding the temperature of the jacket water. When this is considerably below the working temperature, similar troubles are bred to that resulting from a leaky liner. On the other hand, if the circulation be suspended, or there is an insufficiency of tank area, and the cylinder is permitted to grow too hot, pre-ignition may result, and the over-expansion probably strain the liner joint.

ANTI-FLUCTUATOR VALVE.—It is not always that we can insure a constant pressure in our gas supply, important as this feature undoubtedly is. Oftentimes the pressure is so low that it does not suffice to operate the anti-fluctuating valve in the gas bag. It also detrimentally affects the burning of the bunsen flame, and permits the ignition tube to grow cold. When the gas pressure is low, the engine has to wire-draw the gas direct through from the meter, the result being irregular firing. A pressure gauge should be fixed on the gas main between the meter and the bag so that an observation can be kept. If the pressure at any time falls below 15/10 in., it will be advisable to ascertain the reason. The writer has found that the insertion of a light spring attached to the back of the gas bag, and lightly pressing open the valve, is extremely effective in preventing sticking and deflation of the bag, besides insuring a more regular supply of gas to the engine.

INFERIOR OIL.—No oil is too good or too dear. The truth of the axiom that the 'best is cheapest' is borne out by facts made apparent to anyone who has had charge of a gas-engine. Piston troubles are often directly attributable to bad oil. It will not stand up to the heat, quickly carbonizing, getting beneath the rings, and preventing their performing their proper function. Pre-ignition is also in many cases induced by the use of common oils. The dearest cylinder oil obtainable is usually far cheaper in the long run.—*Mechanical World.*

Discussion

Suggested Petroleum Exhibit Panama-Pacific Exposition

The Editor:

Sir—I have read with interest and approval Mr. van Barneveld's general plan for an operating exhibit at the Panama-Pacific Exposition illustrating salient features of the petroleum industry. The Bureau of Mines will coöperate in carrying out this plan as fully as conditions will permit.

J. A. HOLMES.

Washington, D. C., Jan. 26, 1914.

The Editor:

Sir—I thoroughly believe in a comprehensive practical oil exhibit for the Exposition, and deem Mr. van Barneveld's plan an excellent one to accomplish this purpose. The geographical position of the exhibition shoulders the California operators with 90% of the responsibility for the success of the oil exhibit, and I hope they will respond in a manner befitting the position of California as the greatest oil district in the world.

RALPH ARNOLD.

Los Angeles, Cal., Jan. 20, 1914.

The Editor:

Sir—I have read with a great deal of interest the article written by Charles E. van Barneveld, chief of the department of mines and metallurgy. His request for an exhibit of the oil industry of California should appeal to every citizen in the state of California. California is today producing nearly one-third of the oil of the world, and when we consider that the world is looking to California for its oil supply, an exhibit at the Panama-Pacific Exposition would prove the great value and necessity for conserving it to this state and prevent it from going to the world at large at such ridiculously

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low figures as the prices received since its discovery. I would advise that every one read this article as an education concerning the great value to California of the oil industry.

T. SPELLACY.

Los Angeles, Cal., Jan. 17, 1914.

The Editor:

Sir—I have read with care and interest the statement by Charles van Barneveld of the proposed exhibition of the mining and oil industry at the Panama Exposition next year. The plan seems to me to be an excellent one, and I feel sure that it would attract wider attention and be more educative to the public in general that will visit the exhibition, than any other scheme that has been proposed, and I sincerely hope that it may be carried out.

NORMAN BRIDGE.

Los Angeles, Cal., Jan. 21, 1914.

The Editor:

Sir—The Standard Oil Company has very carefully considered the plan proposed by Mr. van Barneveld for a comprehensive exhibit of the oil industry of California, and the plan outlined in his article in *Western Engineering* has our endorsement. We shall be very glad to coöperate with him along the lines indicated. Yours truly,

STANDARD OIL CO.,
K. R. Kingsbury,
Second Vice-President.

The Editor:

Sir—We have read with great interest Mr. van Barneveld's suggestions for the petroleum exhibit at the Panama-Pacific International Exposition. We are heartily in accord with the plans proposed by him, and believe they will most effectually impress the many visitors at this time with the magnitude and extent of this very important Pacific Coast industry.

AMERICAN GASOLINE CO.,
H. K. Gallagher.

San Francisco, California, Feb. 2.

The Editor:

Sir—The manuscript of the article entitled 'A Suggestion for the Mines and Petroleum Exhibit, Panama-Pacific Exposition,' was submitted to me for my criticism before publication. I quite agree with the sentiment expressed that the mining industry of California should have a grand collective exhibit in the Palace of Mines and Metallurgy and in the outdoor space devoted to that department, in which exhibit special prominence should be given to the petroleum branch of the industry. The suggestion that this should be a great joint exhibit made under the auspices of the counties, and that it be financed from the funds which are being raised by special taxation, appeals to me as the only feasible method of securing the right kind of an exhibit from an industry which does not have the ordinary commercial incentive to exhibit. I would like to add to this the assurance that I shall be glad to do anything in my power toward furthering these plans.

S. A. GUIBERSON, Jr.

San Francisco, Cal., Jan. 14, 1914.

The Editor:

Sir—On the subject of Mr. van Barneveld's article advocating concentrated display of the petroleum industry of the state rather than a series of unrelated country displays:

As large producers and refiners of California petroleum, we are most anxious to have the oil industry of the state represented at the Panama-Pacific International Exposition in a manner justified by the importance of the industry of the state. Not many of our own people fully appreciate the importance and magnitude of this great industry. He touches on it in his article when he says that the petroleum production of California is equal to one-quarter of the production of the entire world. In civilized and even in a great many of the most uncivilized countries, petroleum or the manufactured products thereof, are used in some degree by every man, woman, and child.

Our foremost position in the industry should therefore be graphically illustrated, not by selfish individual displays, but through one magnificent reproduction of the industry, picturing the fields, drilling and pumping, the oil strata and formation, pump-houses with pipe-lines to the refinery, transportation by tank steamers and tank cars. Such an exhibit, along the lines suggested in your article, in conjunction with the mining exhibit, would, we believe, illustrate the oil industry and be of great educational and ultimate commercial value to

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the state at large. Individual, commercial, and county exhibits could be grouped about this, the heart of the exhibit, to great advantage, and the several counties interested, as well as the individual manufacturers, would thus in no wise lose their individuality.

We heartily approve of the ideas expressed in his article and believe that the entire idea indicates a broad coöperative spirit, at the same time embodying the greatest individual profit to all participating in and visiting the exposition. If we can be of assistance to you in working out this idea, we will cheerfully do anything in our power.

UNION OIL COMPANY OF CALIFORNIA.
C. G. SHEFFIELD,
Sales Manager.

San Francisco, January 28.

The Editor:

Sir—I beg to acknowledge your letter of January 22, together with copy of article by Mr. van Barneveld. I am most heartily in accord with the ideas expressed therein as to the superior value of a state-wide petroleum exhibit at the Panama-Pacific Exposition compared to its exhibition by numerous individual counties. I am at the present time serving on a committee to which has been assigned the task of assembling and preparing the Fresno county 1915 petroleum exhibit, but I personally believe that it will be impossible for us, in the California Counties Building, to make an exhibit that will attract the attention that the industry deserves. I have maintained for some time that the petroleum industry of this state could not and would not be properly represented at the exposition by a number of individual county exhibits.

I believe if the various counties of this state in which petroleum is produced will coöperate and put into one large exhibit the money and energy which they would otherwise put into their individual petroleum exhibits, that we can give the world the greatest object-lesson in the production and refining of petroleum that it has ever seen.

R. S. HASELTINE.

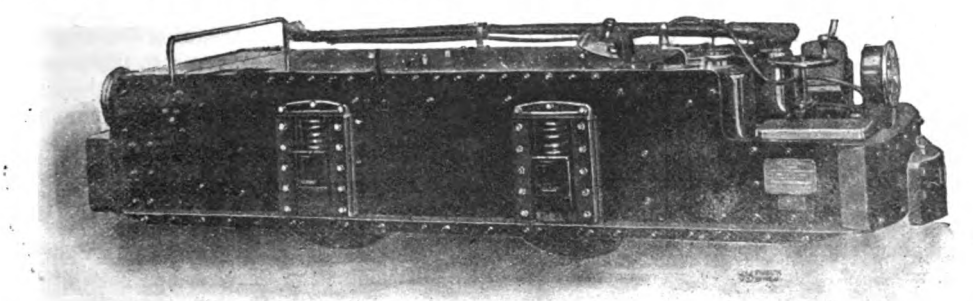
Coalinga, Cal., Jan. 24, 1914.

Industrial Progress

Pioneer Electric Locomotives in Alaska

What are claimed to be the first electric locomotives ever used in Alaska were placed in service within the past few months for mining operations by the Alaska Treadwell Gold Mining Co. at Treadwell, Alaska. This company was incorporated in June 1889 under the laws of the state of Minnesota for the purpose of taking over the Paris mine and reduction works at Douglas island, which had been operated since 1882 by the Alaska Mill & Mining Co. The mine has an immense body of low-grade ore, the property being equipped with two mills having a total of 540 stamps, power-plants, foundry, cyanide plant, machine-shop, sawmill, central hoisting and crushing plant, etc., practically all of which are either operated by electric power or being equipped for electric drive.

Two initial electric mining locomotives are each of six-ton capacity and are operated on a 500-volt direct current circuit from an overhead trolley. These were manufac-



SIX-TON ELECTRIC LOCOMOTIVE.

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tured by the General Electric Co. and are of the standard outside frame type, in which the side frames are placed outside of the wheels. Each machine is equipped with two type HM-801 motors having ball-bearing armatures. The motors are mounted in tandem, whereby one motor is placed in front of the rear axle and the other between the forward axle and the front end frame.

The motors are of the usual series-wound type, and the controller is of the rheostatic magnetic blow-out type. A commutating switch is incorporated in the reverse cylinder, the handle of which has four 'on' positions, two for each direction of motion, one with the motors in series and the other with the motors in multiple. This system of control, by permitting the motors to be started in multiple, allows them to exert their maximum tractive effort independently, so that the slippage of one motor does not affect the other. With the series connections, economy in current consumption is effected while running, for the locomotive will then develop a given drawbar pull with one-half the current required with the motors in multiple, the speed, of course, being reduced in approximately the same ratio.

Some idea of the distance to which the use of electric mining locomotives has now extended in the Far North may be gained when it is stated that the mines at Treadwell are nearly 1000 miles north of Seattle, Washington. The locomotives are operated on the track leading from the central shafthouse to the various mills and haul ore-trains composed of ten or more trailers aggregating a gross trailing load of some 80 tons.

Personal

W. S. Palmer has been appointed president of the Northwestern Pacific Railroad.

George D. Keyser has been appointed Utah State Commissioner for the Lincoln highway.

Frederick W. Huber, chemical engineer, has returned to Los Angeles from a trip to Portland, Oregon, on professional business.

A. W. McLimont has been appointed general manager for the San Francisco-Oakland Terminal Railways, succeeding W. R. Alberger.

E. R. Morgan, state road engineer for Utah, and A. E. Fox, consulting road engineer, have reported to the County Commissioners concerning the specifications to be used for roads to be constructed under the recently authorized $1,000,000 bond issue.

George F. Maddock has been appointed manager of the Department of Examination of Reports for H. M. Byllesby & Co., engineers of Chicago.

George F. Young has opened offices in the Grant building, San Francisco, where he will engage in efficiency engineering and cost-keeping methods.

A. Adiassewich, engineer for the Imperial Russian Department of Commerce and Industry, has been on a tour of inspection through the Midway oilfields.

R. A. Hart, supervising drainage engineer for the U. S. Reclamation Service, has returned to Salt Lake City after a tour of the various reclamation projects in the West.

C. E. Crownover, storage engineer at Meadowbrook, discussed some of the phases of irrigation projects at the recent session of the Washington Irrigation Institute at North Yakima.

Irving C. Allen, of the U. S. Bureau of Mines, addressed the American Chemists' Society in San Francisco, on January 8, with reference to the newly organized American Petroleum Society.

Fred Bonstedt, of the engineering staff of the U. S. Reclamation Service, has recently been in Palouse, Washington, for the purpose of locating dam and reservoir sites for the Palouse project.

A. C. Paulsmeier, chief engineer for the Byron Jackson Iron Works, has returned from a trip to Virginia City, where he inspected the operation of mine pumps recently installed on the Comstock.

William H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, delivered a lecture on 'Organization and Methods of Street Cleaning Departments' before the graduate students in highway engineering at Columbia University.

H. L. Terwilliger has been elected president, H. G. Mitchell, first vice-president, George Olds Orr, secretary, and E. H. Law, assistant secretary, for Harron, Rickard & McCone, of San Francisco.

E. G. Hopson, supervising engineer for the U. S. Reclamation Service, has been at Fallon, Nevada, in conference with D. W. Cole, project engineer, with reference to proposed reclamation work in Douglas county, Nevada, and Alpine county, California.

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Society Meetings

The Spokane sections of the AMERICAN SOCIETY OF CIVIL ENGINEERS, the AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, and the AMERICAN INSTITUTE OF MINING ENGINEERS held a joint meeting at the University of Idaho, at Moscow, on January 17.

The San Francisco section of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold a meeting at the Engineers' Club, Hotel Sutter, on February 10. The topic to be discussed will be 'Transportation of Crude Oil in Pipe-Lines.' E. I. Dyer, Wynn Meredith, A. C. McLaughlin, and E. T. Morris are among those who will participate in the discussion.

The Southern California Association of Members of the AMERICAN SOCIETY OF CIVIL ENGINEERS held its first annual meeting and dinner at the University Club, on January 5, at 6 o'clock. The officers elected for the ensuing year were: J. B. Lippincott, president; Charles T. Leeds, first vice-president; George S. Binckley, second vice-president, W. K. Barnard, secretary, and Charles H. Lee, treasurer. J. C. Ralston read a paper on an 'Estimate of Hydro-Electric Plant and Lighting System,' and J. B. Fiskin a paper on 'Location and Construction of the Little Falls Tie Lands.'

Commercial Paragraphs

MCINTOSH & SEYMOUR, of New York, announce the formation of a corporation with a New York state charter to engage in the manufacture on an extensive scale of a full line of Diesel engines, both stationary and marine. The company will be backed by American and Swedish capitalists who now control the Swedish Diesel Motor Company (Aktiebolaget Diesels Motorer). The latter company is known all over the world as one of the largest and most successful concerns devoted entirely to the manufacture of Diesel engines. These engines are built on the 'Hesselman' system. The new corporation will take over the plant and organization of the McIntosh & Seymour Co. of Auburn, New York. The present steam-engine business will also be continued as heretofore. The name of the new corporation is McIntosh & Seymour Corporation. The board of directors is as follows: Marcus Wallenberg, president Stockholms Enskilda Bank, Stockholm, Sweden; Frank A. Vanderlip, president National City Bank, New York; Thatcher M. Brown, Brown Brothers & Co., New York; Edwin S. Church, Auburn, New York; J. A. Seymour, Auburn, New York; Franklin B. Kirkbride, New York City; Oscar Lamm, Stockholm, Sweden; and Philip W. Henry, New York City. The general counsel is W. M. Coleman of New York City. Edwin S. Church, formerly superintendent of the Akron plant, International Harvester Co., will be executive head of the new corporation. J. A. Seymour, president of the McIntosh & Seymour Co., will be vice-president, in charge of engineering. The initial capitalization will be $2,200,000 half common and half 6% cumulative and participating preferred stock. The Swedish Diesel Motor Co. started building these engines in 1898. Many of their designs of the most important features peculiar to the Diesel engine, such as the fuel pump, the atomizer, details of pistons, etc., have been purchased and adopted by many other leading builders of Diesel engines in Europe. The chief engineer, K. Jonas E. Hesselman, has been knighted by the Swedish Crown in recognition of his distinguished achievements in this line. Most of the important European manufacturers of large steam and gas engines are practically concentrating their energies on building Diesel engines, and have such a large number of orders that it takes them from one to two years to make deliveries. Notwithstanding the increase in the price of fuel oil, the actual cost of fuel oil and its relative cost, as compared with coal, is generally much lower in the United States than in Europe. Also, oil suitable for Diesel engines is a by-product which will always be available in ample quantities as long as the present large consumption of gasoline and kerosene exists. Many large new oilfields are also being developed in this country and Mexico. Not only do Diesel engines offer many advantages for central-station units, factory and other isolated power-plants, and railway service, but are particularly desirable for marine work where weight and space saved is of prime importance. The Diesel oil-engine eliminates the boilers with their necessary handling of coal and ashes, also pumps and many other accessories characteristic of steam equipment. The space so saved, and the coal-bunker space, can be used for cargo, and the

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liquid fuel handled by pumps, and requiring less than one-third of the room required for coal, can be stored in the ship's double bottom. In view of these facts, there seems to be no reason why there should not be a broad field in this country for this type of engine. In addition to furnishing exclusive licenses for their valuable patents for the Western Hemisphere, the Swedish interests in the new American company insure their active aid and coöperation by furnishing a large part of the working capital, and, furthermore, will take an active part in the actual building of the American engines. The McIntosh & Seymour company thoroughly understand American conditions of manufacture and will produce an output suitable for American needs, as well as furnish a highly developed plant and organization adapted for the immediate production of Diesel engines on a large scale. All of this, with the strong financial backing available, certainly assures the success of the new enterprise. Mr. Wallenburg, the principal stockholder of the Swedish Motor Co., and Mr. Hesselman, its chief engineer, have been in this country investigating the situation and the sizes and speeds desirable to conform to American standards and conditions.

Catalogues Received

THOMAS MOULDING CO., Chicago, Ill. Brick fireplaces.

BUCKEYE ENGINE CO., Salem, Ohio. Bulletin 10B, 'The Buckeye-mobile.'

FULTON IRON WORKS, St. Louis. 'Bulletin 800,' covering the Fulton-Tosi oil-engines, Diesel type.

C. H. WHEELER MFG. CO., Philadelphia. Bulletin No. 15, 'Thyssen Entrainment Vacuum Pumps.'

ROBERT W. HUNT & CO., ENGINEERS, 2200 Insurance Exchange, Chicago. 'Employees Bulletin' for December 1913.

W. R. HAYNIE, Hudson Terminal building, New York. Bulletin illustrating and describing the motor tank-ship *Wotan*.

C. F. BRAUN & CO., Hooker & Lent Bdg., San Francisco. Bulletin No. 4, 'Wainwright Feed Water Heater for Marine Service.'

CALIFORNIA CORRUGATED CULVERT CO., West Berkeley and Los Angeles. Catalogue on the Lennon American Ingot Iron Metal Flume.

STEPHENS-ADAMSON MFG. CO., Aurora, Ill. No. 61 of the *Labor Saver*, embodying section 1 of general catalogue No. 19, on power transmission machinery.

NEW LONDON SHIP & ENGINE CO., Groton, Connecticut. Pamphlet illustrating four-cycle, Diesel-type, heavy oil-engines in sizes from 120 to 180 horse-power.

BUCKEYE ENGINE CO., Salem, Ohio. Catalogue of the Buckeye 4-stroke cycle gas-engine. Frank R. Wheeler is San Francisco district manager, with offices in the Rialto building.

The CENTRAL FOUNDRY CO., 90 West St., New York, has issued a new and interesting little booklet showing pictures of many of its prominent universal pipe installations throughout the country.

HENRY R. WORTHINGTON, 115 Broadway, New York. Catalogue on irrigation, showing pumping methods and the aplication of Worthington pumps. General engineering data on this subject is included.

BALDWIN LOCOMOTIVE WORKS. Illustrated pamphlet descriptive of the forty thousandth locomotive manufactured by this company and giving general information and illustrations concerning locomotives of various types.

USINES CARELS FRERES, Ghent, Belgium. W. R. Haynie, U. S. representative, 30 Church street, New York. Catalogue illustrating and describing Carels Diesel engines, including also supplement listing the names of users of this type of engine.

W. R. HAYNIE, 30 Church St., New York. Pamphlet 105 of the Consolidated Diesel Engine Manufacturers, Ltd., descriptive of a large Diesel-engined pumping plant erected at the Gladstone Dock, Liverpool, built jointly by Carels Fréres, of Ghent, Belgium, and the Worthington Pump Co., Ltd., the switchboard and electric equipment having been provided by the British Westinghouse Company.

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletins A4171, 'Ventilated Railway Motors'; A4176, 'High Voltage Oil Break Switch'; A4174, 'Motor Driven Exhaust Fan Outfits'; A4178, 'Three-phase Induction Motor Panels'; A4172, 'Ventilated Commutating Pole Railway Motor'; A4131, 'Storage Battery Industrial and Mining Locomotives'; A4151, 'Engine Driven Continuous Current Generators'; A4167, 'Electricity in Iron Foundries'; A4199, 'Railway Motor Gears and Pinions'; A4143, 'Belt Driven Alternators'; A4189, 'Small Plant Direct Current Switches'; A4197, 'Electric Fans.'

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